

Fossil Energy Research and Development

Table of Contents

	Page
Appropriation Language	11
Overview.....	13
Funding by Site	25
Coal and Other Power.....	35
Clean Coal Power Initiative	49
Central Systems	55
Sequestration R&D	71
Fuels	77
Advanced Research.....	83
Distributed Generation System.....	97
U.S./China Energy & Environmental Center.....	105
Natural Gas Technologies.....	107
Oil Technology	127
Program Direction and Management Support	143
Plant and Capital Equipment.....	149
Fossil Energy Environmental Restoration	151
Import/Export Authorization.....	157
Advanced Metallurgical Research.....	159
National Academy of Sciences Program Review	163
Cooperative Research and Development	165
Energy Efficiency Science Initiative.....	167

Fossil Energy Research and Development

Proposed Appropriation Language

For necessary expenses in carrying out fossil energy research and development activities, under the authority of the Department of Energy Organization Act (Public Law 95–91), including the acquisition of interest, including defeasible and equitable interests in any real property or any facility or for plant or facility acquisition or expansion, and for conducting inquiries, technological investigations and research concerning the extraction, processing, use, and disposal of mineral substances without objectionable social and environmental costs (30 U.S.C. 3, 1602, and 1603), [\$681,163,000] *\$635,799,000*, to remain available until expended, [of which \$4,000,000 is to continue a multi-year project for construction, renovation, furnishing, and demolition or removal of buildings at National Energy Technology Laboratory facilities in Morgantown, West Virginia and Pittsburgh, Pennsylvania; of which not to exceed \$536,000 may be utilized for travel and travel-related expenses incurred by the headquarters staff of the Office of Fossil Energy; *\$287,000,000 is for the Clean Coal Power Initiative, of which \$237,000,000 is to continue a multi-year project coordinated with the private sector for FutureGen, without regard to the terms and conditions applicable to clean coal technology projects: Provided, That the initial planning and research stages of the FutureGen project shall include a matching requirement from non-Federal sources of at least 20 percent of the costs: Provided further, That any demonstration component of such project shall include a matching requirement from non-Federal sources of at least 50 percent of the costs of the component; and of which [\$172,000,000 are] \$50,000,000 is available, after coordination with the private sector, for a request for proposals for a Clean Coal Power Initiative providing for competitively-awarded research, development, and demonstration projects to reduce the barriers to continued and expanded coal use: Provided further, That no project may be selected for which sufficient funding is not available to provide for the total project: Provided further, That funds shall be expended in accordance with the provisions governing the use of funds contained under the heading “Clean Coal Technology” in 42 U.S.C. 5903d: Provided further, That the Department may include provisions for repayment of Government contributions to individual projects in an amount up to the Governments contribution to the project on terms and conditions that are acceptable to the Department including repayments from sale and licensing of technologies from both domestic and foreign transactions: Provided further, That such repayments shall be retained by the Department for future coal-related research, development and demonstration projects, subject to appropriation in advance: Provided further, That any technology selected under this program shall be considered a Clean Coal Technology, and any project selected under this program shall be considered a Clean Coal Technology Project, for the purposes of 42 U.S.C. § 7651n, and Chapters 51, 52, and 60 of title 40 of the Code of Federal Regulations [: Provided further, That no part of the sum herein made available shall be used for the field testing of nuclear explosives in the recovery of oil and gas: Provided further, That up to 4 percent of program direction funds available to the National Energy Technology Laboratory may be used to support Department of Energy activities not included in this account].*

Explanation of Change

.....\$287,000,000 is for the Clean Coal Power Initiative, of which \$237,000,000 is to continue a multi-year project coordinated with the private sector for FutureGen, without regard to the terms and conditions applicable to clean coal technology projects: Provided, That the initial planning and research stages of the FutureGen project shall include a matching requirement from non-Federal sources of at least 20 percent of the costs: Provided further, That any demonstration component of such project shall include a matching requirement from non-Federal sources of at least 50 percent of the costs of the component...

This change provides funding for the continuation of the FutureGen project as a subprogram of the Clean Coal Power Initiative and provides cost sharing guidelines for the initial planning and research phases as well as the demonstration component of the project.

.....: Provided further, That no part of the sum herein made available shall be used for the field testing of nuclear explosives in the recovery of oil and gas...

Language is eliminated in the FY 2005 budget request. Historical efforts have proven that this approach is ineffective in producing oil and gas and the Department believes measures currently in place are sufficient.

.....Provided further, That up to 4 percent of program direction funds available to the National Energy Technology Laboratory may be used to support Department of Energy activities not included in this account...

Language is eliminated in the FY 2005 budget request. Adequate funding is provided in the program direction account to accommodate these activities.

Fossil Energy Research and Development Office of Fossil Energy

Overview

Appropriation Summary by Program

(dollars in thousands)

FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
				\$ Change	% Change

Fossil Energy Research and Development

Coal and Other Power Systems.....	400,622	450,484	450,484	470,000	+19,516	+4.3%
Natural Gas Technologiesy	45,860	42,994	42,994	26,000	-16,994	-39.5%
Petroleum - Oil Technology	40,983	35,078	35,078	15,000	-20,078	-57.2%
Program Direction and Management Support	87,229	106,225	112,599	106,000	-6,599	-5.8%
Plant and Capital Equipment	6,954	6,914	6,914	0	0	0.0%
Fossil Energy Environmental Restoration	9,652	9,595	9,595	6,000	-3,595	-37.5%
Import/Export Authorization.....	2,981	2,716	2,716	1,799	-917	-33.8%
Advanced Metallurgical Processes	5,961	9,876	9,876	8,000	-1,876	-19.0%
National Academy of Sciences Program Review	497	494	494	0	0	0.0%
Cooperative Research and Development	7,970	8,395	8,395	3,000	-5,395	-64.3%
Energy Efficiency Science Initiative.....	2,440	0	0	0	0	0.0%
Total, Fossil Energy Research and Development.....	611,149	672,771	679,330	635,799	-43,531	-6.4%

Detailed Funding Table

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Fossil Energy Research and Development			
Coal and Other Power Systems			
President's Coal Research Initiative			
Clean Coal Power Initiative	145,116	178,770	287,000
Central Systems			
Innovations for Existing Plants	21,566	21,729	18,050
Advanced Systems	69,928	68,151	46,450
Total, Central Systems	91,494	89,880	64,500
Sequestration	39,101	40,297	49,000
Fuels			
Transportation Fuels and Chemicals	21,432	21,927	16,000
Solid Fuels and Feedstocks	5,808	5,986	0
Advanced Fuels Research	3,193	3,308	0
Total, Fuels	30,433	31,221	16,000
Advanced Research			
Coal Utilization Science	8,781	11,852	8,000
Materials	8,712	11,111	8,000
Technology Crosscut	11,078	11,326	10,500
University Coal Research	2,904	2,945	3,000
HBCUs, Education & Training	969	981	1,000
Total, Advanced Research	32,444	38,215	30,500
Total, President's Coal Research Initiative	338,588	378,383	447,000
Other Power Systems			
Distributed Generation Systems			
Fuel Cells	59,107	68,644	23,000
Novel Generation	2,927	2,469	0
Total, Distributed Generation Systems	62,034	71,113	23,000
U.S./China Energy and Environmental Center	0	988	0
Total, Other Power Systems	62,034	72,101	23,000
Total, Coal and Other Power Systems	400,622	450,484	470,000

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Natural Gas Technologies			
Exploration and Production.....	22,712	22,203	17,500
Gas Hydrates.....	9,218	9,383	6,000
Infrastructure.....	8,780	8,939	0
Emerging Processing Technology.....	2,593	0	0
Effective Environmental Protection.....	2,557	2,469	2,500
Total, Natural Gas Technologies.....	45,860	42,994	26,000
Petroleum – Oil Technology			
Exploration and Production.....	22,667	18,450	3,000
Reservoir Life Extension/Management.....	8,724	6,914	5,000
Effective Environmental Protection.....	9,592	9,714	7,000
Total, Petroleum – Oil Technology.....	40,983	35,078	15,000
Program Direction			
Fossil Energy Research and Development.....	87,229	91,410	92,000
Clean Coal Technology.....	0	14,815	14,000
Total, Program Direction.....	87,229	106,225	106,000
Plant and Capital Equipment.....	6,954	6,914	0
Fossil Energy Environmental Restoration.....	9,652	9,595	6,000
Import/Export Authorization.....	2,981	2,716	1,799
Advanced Metallurgical Research.....	5,961	9,876	8,000
National Academy of Sciences Program Review.....	497	494	0
Cooperative Research and Development.....	7,970	8,395	3,000
Energy Efficiency Science Initiative.....	2,440	0	0
Total, Fossil Energy Research and Development.....	611,149	672,771	635,799

Preface

Secure, affordable, and environmentally acceptable energy sources are essential if the people of our Nation and future generations are to maintain a high quality of life. In support of this, the Fossil Energy (FE) Research and Development Program addresses issues related to the supply and use of fossil fuels.

Within the Interior and Related Agencies appropriation, Fossil Energy Research and Development has eleven programs: Coal (two subprograms), Gas (one subprogram), Petroleum (one subprogram), Program Direction (two subprograms), Plant and Capital Equipment, Environmental Restoration, Import/Export Authorization, Advanced Metallurgical Research, National Academy of Science Program Review, Cooperative Research and Development, and the Energy Efficiency Science Initiative.

**Fossil Energy Research and Development/
Overview**

FY 2005 Congressional Budget

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals, and Funding by General Goal. These items together put the appropriation in perspective. This Overview will also address R&D Investment Criteria, Program Assessment Rating Tool (PART), and Significant Program Shifts.

Strategic Context

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission → Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA^a Unit" concept. Within DOE, a GPRA Unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA Unit has completed or will complete a Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA Unit. A numbering scheme has been established for tracking performance and reporting.^b

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GPRA and the President's Management Agenda (PMA).

Mission

The mission of the Fossil Energy (FE) R&D Program is to create public benefits by enhancing U.S. economic, environmental, and energy security. The program carries out three types of activities: (1) managing and performing energy-related research that reduces market barriers to the reliable, efficient and environmentally sound production and use of fossil fuels; (2) partnering with industry and others to advance clean and efficient fossil energy technologies toward commercialization in the U.S. and international markets; and (3) supporting the development of information and policy options that benefit the public by ensuring access to adequate supplies of affordable and clean energy.

Benefits

The extent to which future public benefits are realized from FE R&D activities are a complex function of factors including: success meeting R&D goals; competition from other advanced technologies; future energy prices; and the future regulatory environment. Since the future of markets and regulations are uncertain, alternative, credible scenarios need to be considered. A summary of the methodologies,

^a Government Performance and Results Act of 1993

^b The number scheme uses the the following numbering convention: First 2 digits identify the General Goal (01 through 07); second two digits identify the GPRA Unit; last four digits are reserved for future use.

sensitivities, and assumptions used to develop benefits estimates are important and these estimates should not be cited or referenced without their inclusion. This information will be available on the DOE/Fossil Energy website (<http://www.fe.doe.gov>) by March, 2004. Assessment with the PART revealed that the Department needs to continue to improve the consistency in methodology in estimating benefits for applied R & D programs across the Department.

Strategic Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspect of the mission plus seven general goals that tie to the strategic goals. The Fossil Energy Research and Development appropriation supports the following goals:

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The programs funded by the Fossil Energy appropriation have the following three Program Goals which contribute to the General Goals in the "goal cascade":

Program Goal 04.55.00.00: Zero Emissions Coal-Based Electricity and Hydrogen Production: Create public/private partnerships to provide technology to ensure continued electricity production from the extensive U.S. fossil fuel resource, including control technologies to permit reasonable-cost compliance with emerging regulations, and ultimately, by 2015, zero emission plants (including carbon) that are fuel-flexible, and capable of multi-product output and efficiencies over 60 percent with coal and 75 percent with natural gas.

Program Goal 04.56.00.00: Natural Gas Technologies, Abundant Affordable Gas: The Natural Gas Technologies' goal is to provide technology and policy options capable of ensuring abundant, reliable, and environmentally sound gas supplies.

Program Goal 04.57.00.00: Oil Technology, Energy Security: The goal of the Oil Technology program is to enhance U.S. energy security by managing and funding oil exploration and production (E&P) research and policy which results in development of domestic oil resources in an environmentally sound and safe manner.

Contribution to General Goals

FE contributes to General Goal 4 through its Coal and Other Power Systems, Natural Gas Technologies, and Oil Technology Programs.

The Coal and Other Power Systems Program (\$470 million FY 2005 Request/\$450.5 million FY 2004) contributes by creating public/private partnerships to provide technology to ensure continued electricity production from the extensive U.S. fossil fuel resource, including control technologies to permit reasonable-cost compliance with emerging regulations, and ultimately, by 2015, zero emission plants (including carbon) that are fuel-flexible, and capable of multi-product output and efficiencies over 60% with coal and 75% with natural gas.

One component of this program is the President's Coal Research Initiative, which includes the Clean Coal Power Initiative (CCPI) and supporting research programs. Beginning in FY 2005, the Clean Coal Power Initiative includes the FutureGen research project designed to establish the capability and feasibility of co-producing electricity and hydrogen from coal with essentially zero emissions, including carbon (sequestration). The Administration's FY 2005 request for FutureGen is \$237 million. The Clean Coal Power Initiative demonstration projects (\$50.0 million FY 2005 Request/\$169.9 million FY 2004), are cost-shared partnerships between the government and industry to demonstrate advanced coal-based power generation technologies (the most advanced example of which will be FutureGen).

The President's Coal Research Initiative also includes a number of important supporting research programs:

- Innovations for Existing Plants (\$18.1 million FY 2005 Request/\$21.7 million FY 2004) supports the President's Clear Skies Initiative by having technologies ready for commercial demonstration between 2005 and 2010 that can achieve substantial reductions in mercury, NO_x, and SO₂ emissions from power plants at significantly lower costs than currently available technology. This includes reductions of: mercury by 50 - 70 percent at 70 percent of today's cost; NO_x to less than 0.15 lb/mmBtu at three-quarters the cost of Selective Catalytic Reduction; and PM2.5 by 99.99 percent for less than \$50-\$70/Kw. By 2010, technologies will be tested for reducing mercury by 90 percent at 70 percent of today's cost.
- Advanced Power Systems (\$46.5 million FY 2005 Request/\$68.2 million FY 2004) supports the development of ultra-high efficiency coal powerplants for central station applications that will significantly reduce greenhouse gases compared to the existing fleet with costs at or below current technology. The primary focus is integrated gasification combined cycle (IGCC) and turbines that can use coal-derived gas. This includes, by 2010, demonstrating technologies at pilot scale which validate the feasibility of an advanced IGCC capable of achieving 50% thermal efficiency at a capital cost of \$1000/kW or less for a coal-based plant.
- Achieving zero carbon emissions will require economic approaches for carbon capture and storage. The goal for Sequestration R&D (\$49.0 million FY 2005 Request/\$40.5 million FY 2004) is to demonstrate, by 2007, technologies to reduce the cost of carbon separation and capture from new coal-based power systems by 75 percent compared to current systems (\$200/tonne carbon in year 2000), as well as creating regional partnerships for investigating potential sites and studies of the needs for essential infrastructure and permitting processes. By 2012, technologies will be developed that result in less than 10 percent increase in the cost of new energy services to separate, capture, transport, and sequester carbon using either direct or indirect systems.
- Making affordable hydrogen fuels available will create a potential pathway to zero emission vehicles, and would be particularly attractive if hydrogen can be generated with minimal emissions. Fossil fuels are considered to be the most cost-effective initial source of hydrogen, and by 2010, the goal for Coal Fuels Research under the President's Hydrogen Fuels Initiative (\$16.0 million FY 2005 Request/\$4.9 million FY 2004) is to complete development of modules capable of co-producing hydrogen from coal at \$30/barrel crude oil equivalent (no incentives or tax credits) when integrated with advanced coal power systems.

- Successful R&D depends on a program to ensure the availability of fundamental enabling technologies. Advanced Research activities (\$30.5 million FY 2005 Request/\$38.2 million FY 2004) contribute to sustaining U.S. preeminence in fossil fuel technology by supporting development of material, computational method, and control system knowledge needed to bridge gaps between science and advanced engineering. This activity will allow development, by 2010, of enabling technologies that support the goals of Vision 21 power systems.

The remaining area under Coal and Other Power Systems Distributed Generation (\$23.0 million FY 2005 Request/\$71.1 million FY 2004) focuses on cost and efficiency improvements for smaller scale electricity generation applications. It seeks, by 2010, to increase the robustness of distributed generation and thereby lower vulnerability of the electricity grid by introducing prototypes of modular fuel cells with 10-fold cost reduction (\$400/kW) with 50% - 60% efficiency, and fuel cell-turbine hybrids with 70% - 75% efficiency adaptable for coal.

The Natural Gas Technologies Program (\$26.0 million FY 2005 Request/\$43.0 FY 2004) contributes to Goal 4 by providing technology and policy options capable of ensuring (more safely and with greater security) abundant, affordable, reliable, and environmentally sound gas supplies. Program elements will develop technologies in the near, mid and long term to increase domestic supplies of conventional gas, and gas from vast unconventional sources such as methane hydrates, and ensure an adequate storage capability. Related policy efforts will provide import/export oversight and authorization to facilitate free natural gas and LNG markets among our international trading partners.

The Oil Technology Program (\$15.0 million FY 2005 Request/\$35.1 million FY 2004) supports General Goal 4 by providing technology and policy options capable of ensuring oil conservation and increasing energy security through development of existing domestic oil resources in an environmentally sound and safe manner.

This program has been realigned to specifically support the President's climate change and energy security goals. The budget delineates program goals such as Enhanced Oil Recovery/CO₂ Injection, Domestic Resource Conservation, and Environmental Science as funding categories. This allows the program to narrow the focus and highlight the program's mission and goals. These investments will maximize public benefit by concentrating solely on activities that require a Federal presence to attain the President's climate change and energy security goals. For the short term, the program focuses on working with domestic suppliers to maintain existing reserves and on diversifying global oil supplies. For the mid- to longer-term, the program seeks better technology that can be applied to locate new horizons. For the long-term, the program is defining frontiers of oil production that can provide a greater amount of the Nation's petroleum needs. This will help to ensure that an adequate supply of reasonably priced oil is available to meet the expected demand while minimizing environmental impact.

Funding by General Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Goal 4, Energy Security					
Coal and Other Power Systems					
President's Coal Research Initiative					
Clean Coal Power Initiative.....	145,116	178,770	287,000	+108,230	+60.5%
Central Systems.....	91,494	89,880	64,500	-25,380	-28.2%
Sequestration R&D	39,101	40,297	49,000	+8,703	+21.6%
Fuels	30,433	31,221	16,000	-15,221	-48.8%
Advanced Research.....	32,444	38,215	30,500	-7,715	-20.2%
Total, President's Coal Research Initiative.....	338,588	378,383	447,000	+68,617	+18.1%
Other Power Systems					
Distributed Generation Systems	62,034	71,113	23,000	-48,113	-67.7%
U.S./China Energy and Environmental Center	0	988	9	-988	-100.0%
Total, Other Power Systems	62,034	72,101	23,000	-49,101	-68.1%
Total, Coal and Other Power Systems	400,622	450,484	470,000	+19,516	+4.3%
Natural Gas Technologies.....	45,860	42,994	26,000	-16,994	-39.5%
Petroleum - Oil Technology.....	40,983	35,078	15,000	-20,078	-57.2%
Advanced Metallurgical Processes.....	5,961	9,876	8,000	-1,876	-19.0%
Total Goal 4, Energy Security.....	493,426	538,432	519,000	-19,432	-3.6%
All Other					
Program Direction and Management Support.....	87,229	106,225	106,000	-225	-0.2%
Plant and Capital Equipment	6,954	6,914	0	-6,914	-100.0%
Fossil Energy Environmental Restoration.....	9,652	9,595	6,000	-3,595	-37.5%
Import/Export Authorization.....	2,981	2,716	1,799	-917	-33.8%
National Academy of Sciences Program Review.....	497	494	0	-494	-100.0%
Cooperative Research and Development	7,970	8,395	3,000	-5,395	-64.3%
Energy Efficiency Science Initiative	2,440	0	0	0	-0.0%
Total, All Other.....	117,723	134,339	116,799	-17,540	-13.0%
Total, General Goal 4 (Fossil Energy Research and Development)	611,149	672,771	635,799	-36,972	-5.5%

R&D Investment Criteria

For the FY 2005 budget process OMB made revisions to its Program Assessment and Rating Tool (PART) to ensure alignment with the R&D Investment Criteria. There was additional information generated under the R&D Investment Criteria for the FY 2004 process, such as years to commercialization and level of risk that was also developed by Fossil Energy in the FY 2005 process. As a result of developing this additional information and using the updated PART, the breadth of items included in the R&D Investment Criteria was fully covered.

The President's Management Agenda identified the need to tie R&D investment to performance and well-defined practical outcomes. One criterion by which the Department's performance is measured involves using a framework in the R&D funding decision process and then referencing the use and outcome of the framework in budget justification material.

The goal is to develop highly analytical justifications for applied research portfolios in future budgets. This will require the development and application of a uniform cost and benefit evaluation methodology across programs to allow meaningful program comparisons.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget (OMB) to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The current focus is to establish out-come and output-oriented goals, the successful completion of which will lead to benefits to the public, such as increased national security and energy security, and improved environmental conditions. DOE has incorporated feedback from OMB into the FY 2005 Budget Request, and the Department will take the necessary steps to continue to improve performance.

Based on application of the PART:

- 1) The oil and natural gas technology programs are rated as ineffective, and these programs lack a rigorous peer review process;
- 2) The fuel cell program is adequate, well designed, planned, and managed.
- 3) The Coal Research Initiative is adequate, with a clear purpose.

In general, the Department needs to improve consistency in methodology and assumptions in estimating potential benefits of all applied R & D programs.

Significant Program Shifts

The most significant shift is the focusing of the Coal and Power Systems funding on the FutureGen research project designed to establish the capability and feasibility of co-producing electricity and hydrogen from coal with essentially zero emissions, including carbon (via sequestration). The \$237 million dollar FY 2005 request is a major commitment by the Administration, and signals the private sector and potential international partners that the Administration is serious about carrying out this project.

In addition, the FY 2005 Request reflects significantly increased funding in support of the President's Hydrogen Fuels Initiative through the development of advanced technology for producing hydrogen from coal. Another area receiving increasing emphasis is carbon sequestration, in part based on activities that will result from the FY 2004 initiation of the Carbon Sequestration Leadership Forum and seven Regional Partnerships.

Congressional Items of Interest

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
NETL Office/Lab Building	3,974	3,951	0	-3,951	-100.0%
Total, Congressional Items of Interest ..	3,974	3,951	0	-3,951	-100.0%

Fossil Energy Research and Development

Office of Fossil Energy

Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Chicago Operations Office					
Ames National Laboratory					
Coal and Power Systems	487	500	480	-20	-4.0%
Total, Ames National Laboratory	487	500	480	-20	-4.0%
Argonne National Laboratory (East)					
Coal and Other Power Systems	3,885	3,582	2,802	-780	-21.7%
Natural Gas Technologies	298	210	0	-210	-100.0%
Total, Argonne National Laboratory (East)	4,183	3,792	2,802	-990	-26.1%
Brookhaven National Laboratory					
Coal and Other Power Systems	200	200	100	-100	-50.0%
Total, Brookhaven National Laboratory	200	200	100	-100	-50.0%
Total, Chicago Operations Office	4,870	4,492	3,382	-1,110	-24.7%
Idaho Operations Office					
Idaho National Engineering and Environmental Lab					
Coal and Other Power Systems	850	850	570	-280	-32.9%
Natural Gas Technologies	300	100	0	-100	-100.0%
Petroleum – Oil Technology	343	0	0	0	0.0%
Total, Idaho National Engineering and Environmental Lab.....	1,493	950	570	-380	-40.0%
Total, Idaho Operations Office.....	1,493	950	570	-380	-40.0%
Livermore Site Office					
Lawrence Livermore National Laboratory					
Coal and Other Power Systems	0	140	0	-140	-100.0%
Natural Gas Technologies	150	250	0	-250	-100.0%
Petroleum – Oil Technology	302	200	175	-25	-12.5%

**Fossil Energy Research and Development/
Funding by Site**

FY 2005 Congressional Budget

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Total, Lawrence Livermore National Laboratory	452	590	175	-415	-70.3%
Total, Livermore Site Office	452	590	175	-415	-70.3%
Los Alamos Site Office					
Los Alamos National Laboratory					
Coal and Other Power Systems	1,775	1,834	1,300	-534	-29.1%
Natural Gas Technologies	150	300	0	-300	-100.0%
Petroleum – Oil Technology	825	50	0	-50	-100.0%
Total, Los Alamos National Laboratory	2,750	2,184	1,300	-884	-40.4%
Total, Los Alamos Site Office	2,750	2,184	1,300	-884	-40.4%
National Energy Technology Laboratory					
National Energy Technology Laboratory					
Coal and Other Power Systems	358,414	394,973	416,089	+21,116	+5.3%
Natural Gas Technologies	40,959	37,336	24,385	-12,951	-34.6%
Petroleum – Oil Technology	36,040	31,804	14,550	-17,254	-54.2%
Program Direction and Management Support	68,452	79,196	78,851	-345	-0.4%
Plant and Capital Equipment	6,954	6,914	0	-6,914	-100.0%
Fossil Energy Environmental Restoration	8,569	8,401	5,242	-3,159	-37.6%
Cooperative Research and Development	3,965	4,177	1,480	-2,697	-64.5%
Advanced Metallurgical Research ..	5,961	9,876	8,000	-1,876	-18.9%
Total, National Energy Technology Laboratory	529,314	572,677	548,597	-24,080	-4.2%
NNSA Service Center					
Lawrence Berkeley National Laboratory					
Coal and Other Power Systems	200	580	100	-480	-82.7%
Natural Gas Technologies	1,250	850	300	-550	-64.7%
Petroleum – Oil Technology	500	200	125	-75	-37.5%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Total, Lawrence Berkeley National Laboratory	1,950	1,630	525	-1,105	-67.7%
Total, NNSA Service Center	1,950	1,630	525	-1,105	-67.7%
Oak Ridge Operations Office					
Oak Ridge National Laboratory					
Coal and Power Systems	5,488	6,089	4,580	-1,509	-24.7%
Natural Gas Technologies	260	510	0	-510	-100.0%
Petroleum – Oil Technology	640	0	0	0	0.0%
Total, Oak Ridge National Laboratory	6,388	6,599	4,580	-2,019	-30.5%
Total, Oak Ridge Operations Office.....	6,388	6,599	4,580	-2,019	-30.5%
Richland Operations Office					
Pacific Northwest Laboratory					
Coal and Power Systems	7,290	9,358	5,090	-4,268	-45.6%
Natural Gas Technologies	350	275	0	-275	-100.0%
Total, Pacific Northwest Laboratory ..	7,640	9,633	5,090	-4,543	-47.1%
Total, Richland Operations Office.....	7,640	9,633	5,090	-4,543	-47.1%
Sandia Site Office					
Sandia National Laboratories					
Coal and Power Systems	600	900	550	-350	-38.8%
Natural Gas Technologies	686	340	0	-340	-100.0%
Total, Sandia National Laboratories ..	1,286	1,240	550	-690	-55.6%
Total, Sandia Site Office	1,286	1,240	550	-690	-55.6%
Washington Headquarters					
Coal and Power Systems	21,433	31,478	38,339	+6,861	+21.7%
Natural Gas Technologies	1,457	2,823	1,315	-1,508	-53.4%
Petroleum – Oil Technology	2,333	2,824	150	-2,674	-94.6%
Program Direction and Management Support	18,777	27,029	27,149	+120	+0.4%
Fossil Energy Environmental Restoration	1,083	1,194	758	-436	-36.5%

Fossil Energy Research and Development/
Funding by Site

FY 2005 Congressional Budget

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Import/Export Authorization	2,981	2,716	1,799	-917	-33.7%
National Academy of Sciences Program Review	497	494	0	-494	-100.0%
Cooperative Research and Development.....	4,005	4,218	1,520	-2,698	-63.9%
Energy Efficiency Science Initiative.....	2,440	0	0	0	0.0%
Total, Washington Headquarters.....	55,006	72,776	71,030	-1,746	-2.3%
Total, Fossil Energy Research and Development.....	611,149	672,771	635,799	-36,972	-5.4%

Site Description

Ames National Laboratory

The Ames National Laboratory is located in Ames, Iowa.

Coal and Other Power Systems

Ames National laboratory conducts advanced research on virtual simulations and high temperature materials.

Argonne National Laboratory (East)

The Argonne National Laboratory (ANL), located in Argonne, Illinois, is a major multi-program laboratory managed and operated for the U.S. Department of Energy (DOE) by the University of Chicago under a performance-based contract.

Coal and Other Power Systems

Argonne research supports concepts for various technologies for Central Systems; supports DOE strategies to capture CO₂ from existing and advanced fossil fuel conversion systems in Sequestration R&D; supports DOE strategies to develop non-destructive testing examination of materials and mineral sequestration kinetics in the Advanced Research; and supports the DOE-SECA core technology program in Distributed Generation Systems.

Natural Gas Technologies

Argonne research for the Fossil Energy Natural Gas Technologies program in FY 2003 supported Drilling, Completion and Stimulation technology development and Environmental Science R&D. No activities are planned in FY 2004 and FY 2005.

Brookhaven National Laboratory

The Brookhaven National Laboratory (BNL) is located on Long Island, New York.

Coal and Other Power Systems

The Brookhaven National Laboratory conducts research on various technologies for central systems.

Idaho National Engineering and Environmental Laboratory

The Idaho National Engineering and Environmental Laboratory (INEEL) is located outside of Idaho Falls, Idaho.

Coal and Other Power Systems

Research conducted at INEEL supports concepts for various technologies for Central Systems; conducts research on breakthrough concepts to separate and capture CO₂ in Sequestration R&D; and conducts research and development on materials development and bio-processing research in Advanced Research.

Natural Gas Technologies

Research conducted in FY 2003 supported environmental technology development, drilling technology and microbial analysis of gas hydrates, and small pipe development. In FY 2004 and FY 2005 no activity is planned.

Petroleum – Oil Technology

Research conducted in FY 2003 supported microbial enhanced oil recovery (MEOR) and environmental research. In FY 2004 and FY 2005 no activity is planned.

Lawrence Berkeley National Laboratory

The Lawrence Berkeley National Lab (LBNL) is located in Berkeley, California.

Coal and Other Power Systems

The Lawrence Berkeley National Lab conducts research which supports concepts for various technologies for Central Systems; and conducts research and development on geologic sequestration approaches and measurement, monitoring, and verification protocols in Sequestration R&D.

Natural Gas Technologies

Research conducted in FY 2003 and FY 2004 supported environmental analysis and modeling, heavy oil upgrading, reservoir characterization, and gas hydrates characterization. Some reservoir characterization activities will continue in FY 2005.

Petroleum – Oil Technology

Research supports enhanced oil recovery (EOR) and environmental modeling.

Lawrence Livermore National Laboratory

The Lawrence Livermore National Lab (LLNL) is located in Livermore, California.

**Fossil Energy Research and Development/
Funding by Site**

FY 2005 Congressional Budget

Natural Gas Technologies

Research conducted in FY 2003 supported environmental emissions analysis, reservoir geophysics, and hydrates properties, and hyperspectral remote leak detection. No activity is planned in FY 2004 or FY 2005.

Petroleum – Oil Technology

Research supports environmental and reservoir modeling.

Los Alamos National Laboratory

The Los Alamos National Laboratory (LANL) is located in Los Alamos, New Mexico.

Coal and Other Power Systems

Research conducted by the Los Alamos National Laboratory supports concepts for various technologies for Central Systems; conducts research and development in the area of Sequestration R&D to lower the costs of CO₂ capture, provide fundamental scientific information on engineered terrestrial sequestration approaches, and develop advanced instrumentation to measure and validate terrestrially sequestered carbon; and conducts research and development in the area of Advanced Research to model mineral sequestration and develop hydrogen separation membranes.

Natural Gas Technologies

Research conducted in FY 2003 supported multi-purpose energy meter. No activity is planned in FY 2004 or FY 2005.

Petroleum – Oil Technology

Research conducted in FY 2003 supported seismic and drilling research. No activity is planned in FY 2004 or FY 2005.

National Energy Technology Laboratory

The National Energy Technology Laboratory (NETL), located in Morgantown, West Virginia, Pittsburgh, Pennsylvania, and Tulsa, Oklahoma, is a multi-purpose laboratory, owned and operated by the U.S. Department of Energy. NETL conducts and implements science and technology development programs for the Department in energy and energy-related environmental systems. NETL's key functions are to shape, fund, and manage extramural (external) RD&D projects, conduct on-site science and technology research, and support energy policy development and best business practices within the Department.

Coal and Other Power Systems

Scientists and engineers at the National Energy Technology Laboratory (NETL) conduct basic and applied research and development in support of the Office of Coal and Power Systems programs. In-house research in the coal gasification area involves advanced materials testing; gas-stream pollutant removal; sorbents development; particulate removal; and membrane separations. NETL researchers are also working to improve the next generation of gas turbines, fuel cells, and coupled turbine-fuel cell systems. In-house emissions control research focuses on the problems of Hg and PM_{2.5} because these will be regulated in the

relatively near future, while the by-product utilization in-house research solves environmental problems related to wastes and by-products formed during combustion processes. Research in carbon sequestration science studies the scientific basis for carbon sequestration options for large stationary sources of CO₂. Finally, research in computational energy science is being conducted to utilize advanced simulation techniques to improve and speed the development of cleaner, more efficient energy devices and plants.

Natural Gas Technologies

Within the Natural Gas Program, NETL has unique capability in hydrogen testing, computational chemistry, laser ignition development, and plastic pipe defect detection. With the exception of laser ignition development and plastic pipe defect detection, these functions will continue in FY 2004. Support for gas hydrates and natural gas resource assessment will continue in FY 2005.

Petroleum – Oil Technology

Specific onsite expertise in enhanced oil recovery (EOR), environmental science, computational chemistry, and policy analysis supports the Oil Technology Program.

Program Direction and Management Support

This activity provides funding for salaries, benefits and overhead expenses for management of the Fossil Energy (FE) program at the National Energy Technology Laboratory (NETL), with sites in Morgantown, WV, Pittsburgh, PA, and Tulsa, OK.

Plant and Capital Equipment

This activity provides funding for general plant projects at the National Energy Technology Laboratory (NETL), with sites in Morgantown, WV, Pittsburgh, PA, and Tulsa, OK; and the Albany Research Center. Funding is also included for the 7-year project for construction, renovation, furnishing, and demolition or removal of buildings at NETL facilities in Morgantown, West Virginia, and Pittsburgh, Pennsylvania.

Fossil Energy Environmental Restoration

Activities are to ensure protection of workers, the public, and the environment in performing the mission of the National Energy Technology Laboratory (NETL) at the Morgantown, West Virginia, Pittsburgh, Pennsylvania, and Tulsa, Oklahoma sites, and the Albany Research Center at Albany, Oregon.

Oak Ridge National Laboratory

The Oak Ridge National Laboratory (ORNL) is located in Oak Ridge, Tennessee.

Coal and Other Power Systems

The Oak Ridge National Laboratory conducts research on advanced materials that are applicable to advanced coal based power generation systems such as Vision 21 in Central Systems; conducts research and development in the area of Sequestration R&D to further geologic sequestration concepts, including measurement, monitoring and verification, and to understand the important soil parameters that facilitate terrestrial sequestration; and conducts research and development in the area of Advanced Research to develop materials and perform bio-processing research.

Natural Gas Technologies

Research conducted in FY 2003 supported oil processing environmental mitigation technologies and characterization of gas hydrates. ORNL has unique capabilities in petroleum product physical measurements, and EMAT sensor development. No specific activities are planned in FY 2004 or FY 2005.

Pacific Northwest Laboratory

The Pacific Northwest Laboratory (PNNL) is located in Richland, Washington.

Coal and Other Power Systems

The Pacific Northwest Laboratory conducts research and development in the area of Advanced Research to perform materials research and environmental analyses; and conducts research and development in the area of Distributed Generation Systems in support of the DOE-SECA program.

Natural Gas Technologies

Research conducted in FY 2003 supported reservoir geophysics, hydrate characterization, and ultrasonic strain detection. No activity is planned in FY 2004 or FY 2005.

Sandia National Laboratories

The Sandia National Laboratory (SNL) is located in Albuquerque, New Mexico, and Livermore, California.

Coal and Other Power Systems

The Sandia National Laboratories conducts research and development in the area of Sequestration R&D on injection of CO₂ into depleted oil and gas formations, and advanced monitoring methodologies based on advances seismic concepts; and conducts research and development in the area of Advanced Research to develop hydrogen separation membranes and conduct fundamental combustion research.

Natural Gas Technologies

Research conducted in FY 2003 supported air emissions detection, measurement while drilling technology, reservoir geomechanical analysis, and airborne leak detection. No activity is planned in FY 2004 or FY 2005.

Washington Headquarters

Coal and Other Power Systems

This funding provides program support and technical support for each of the program within the Coal and Other Power Systems Program.

Natural Gas Technologies

The funding provides program support and technical support.

Petroleum – Oil Technology

The funding provides program support and technical support.

Program Direction and Management Support

This activity provides funding for salaries, benefits and overhead expenses for management of the Fossil Energy (FE) program at Headquarters.

Fossil Energy Environmental Restoration

The funding provides program support and technical support.

Import/Export Authorization

The Office of Import/Export Authorization manages the regulatory review of natural gas imports and exports, exports of electricity, and the construction and operation of electric transmission lines which cross U.S. international borders.

National Academy of Sciences Program Review

This program provide for a study, in FY 2003, by the National Research Council (NRC) of prospective future benefits of Fossil Energy R&D.

Cooperative Research and Development

The funding provides program support and technical support.

Other**Coal and Other Power Systems**

- The Clean Coal Power Initiative subprogram funds research at major performers at non-DOE locations. Examples of these performers include Otter Tail Power Corp. with UNDEERC and W. L. Gore & Associates, Tampa Electric, Universal Aggregates, LLC., Sunflower Electric Power Corp., CONSOL Energy, Inc., TIAX, LLC., JEA, Air Products Liquid Phase Conversion Co., and Kentucky Pioneer Energy, Ltd. with Fuel Cell Energy and Global Energy.
- The Central Systems subprogram funds research at major performers at non-DOE locations. An example of these performers include the Albany Research Center focusing on various advanced materials and process-related concepts.
- The Sequestration R&D subprogram funds research at major performers at non-DOE locations. Examples of these performers include the CO₂ Capture Project (CCP), a collaborative effort involving nine major international energy companies, that has the goal of developing advanced technologies to significantly (75%) reduce the costs of capturing CO₂ from fossil fuel energy systems, an advanced fossil fuel conversion process with inherent CO₂ capture (Alstom), development of a combined membrane-fossil fuel combustion system that would produce a pure stream of CO₂ for sequestration (Praxair), and testing a regenerable sobent system capable of capturing CO₂ from advanced coal gasification systems (RTI). The Sequestration R&D subprogram also funds research at major colleges and universities—developing an accurate cost and performance model for CO₂ capture systems (CMU); using hardwoods to restore mine lands (University of Kentucky); developing a carbon management geographic information system (MIT)—and at non-governmental organizations such as the Nature Conservancy who is developing a carbon accounting system for large forest ecosystems.

- The Fuels subprogram funds research at major performers at non-DOE locations. Examples of these performers include APCI, Texaco and Praxair.
- The Advanced Research subprogram funds research at major performers at non-DOE locations. An example of these performers include, the Albany Research Center which conducts research on materials and mineralization sequestration processes.
- The Distributed Generation Systems subprogram funds research at major performers at non-DOE locations. Examples of these performers include the SECA industry teams and SECA core technology teams.

Natural Gas Technologies

The Department's Natural Gas Technologies program, within the Fossil Energy and Development program, funds research at major performers at non-DOE locations. Examples of these performers include partnerships with industry, universities, national laboratories, state and local governments, and other organizations. Private sector participation is emphasized through industry cost-sharing with individual companies and consortia to ensure market relevance and to facilitate the transfer of technology to the private sector while leveraging Federal R&D investment. University research supported by this program contributes to U.S. technological leadership.

Petroleum – Oil Technology

The Department's Oil Technology program, within the Fossil Energy and Development program, funds research at major performers at non-DOE locations. Examples of these performers include partnerships with industry, universities, state and local governments, and other organizations. Private sector participation is emphasized through industry cost-sharing with individual companies and consortia to ensure market relevance and to facilitate the transfer of technology to the private sector while leveraging Federal R&D investment.

Fossil Energy Environmental Restoration

Activities include environmental protection, and cleanup activities at several former off-site research and development locations.

Advanced Metallurgical Processes

The Advanced Metallurgical Processes program conducts inquiries, technological investigations, and research concerning the extraction, processing, use, and disposal of mineral substances under the mineral and materials science program at the Albany Research Center in Oregon.

Cooperative Research and Development

Provides the federal share of support for Jointly Sponsored Research Programs (JSRP) at the Western Research Institute (WRI) and the University of North Dakota Energy and Environmental Research Center (UNDEERC).

Coal and Other Power Systems

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Coal and Other Power Systems						
President's Coal Research Initiative						
Clean Coal Power Initiative.....	145,116	178,770	178,770	287,000	+108,230	+60.5%
Central Systems	91,494	89,880	89,880	64,500	-25,380	-28.2%
Sequestration	39,101	40,297	40,297	49,000	+8,703	+21.6%
Fuels	30,433	31,221	31,221	16,000	-15,221	-48.8%
Advanced Research	32,444	38,215	38,215	30,500	-7,715	-20.2%
Subtotal, President's Coal Research Initiative ..	338,588	378,383	378,383	447,000	+68,617	+18.1%
Other Power Systems						
Distributed Generation Systems	62,034	71,113	71,113	23,000	-48,113	-67.7%
U.S./China Energy and Environmental Center	0	988	988	0	-988	-100.0%
Subtotal, Other Power Systems	62,034	72,101	72,101	23,000	-49,101	-68.1%
Total, Coal and Other Power Systems	400,622	450,484	450,484	470,000	+19,516	+4.3%

Mission

The mission of the Coal and Other Power Systems program is to assure the availability of abundant low cost, domestic energy (including hydrogen) to fuel economic prosperity and strengthen energy security.

Benefits

The Coal and Other Power Systems program supports DOE's overarching mission to achieve national energy security in an economic and environmentally sound manor by developing the technological capability to eliminate all environmental concerns associated with coal use. In the near term this means having the ability to meet all existing and anticipated environmental regulations at low cost and to

increase the power generation efficiency for existing and new plants. Moreover, in the longer term, the aim is to nearly double coal power plant efficiencies (from 33% to 60%), create the capability to produce low cost hydrogen from coal and to sequester (capture and store) all carbon from future coal plants at affordable costs of electricity, allowing coal to remain a key, strategic fuel for the Nation. The program mission is carried out in support of several key Presidential Initiatives including the Coal Research Initiative, Clear Skies Initiative, Global Climate Change Initiative, Hydrogen Fuel Initiative, and the FutureGen Initiative.

Background

President's Coal Research Initiative

The goal of the President's Coal Research Initiative is to produce public benefits by conducting research and development on coal-related technologies that will improve coal's competitiveness in future energy supply markets. The Administration strongly supports coal as an important part of our energy portfolio. This request carries out the President's campaign commitment to spend \$2 billion on clean coal research over 10 years.

The President's Coal Research Initiative consists of the Clean Coal Power Initiative, which embodies both an industry-led, cost-shared research and development program, and FutureGen, a prototype facility that will produce electricity and hydrogen while sequestering one million metric tons of carbon dioxide per year; Central Systems, targeting central station power generation equipment including low cost emissions control technology (especially mercury); Sequestration R&D, researching ways to mitigate or separate and dispose of greenhouse gas from combustion; and Advanced Research, a set of cross-cutting long-term research projects that can potentially contribute to many aspects of the coal research program. Each of these programs is described in detail in separate sections below.

Other Power Systems

A confluence of utility restructuring, technology evolution, public environmental policy, and an expanding electricity market are providing the impetus for distributed generation to become an important energy option.

Distributed generation is the strategic application of relatively small generating units (typically less than 30 MWe) at or near consumer sites to meet specific customer needs, to support economic operation of the existing power distribution grid, or both. Reliability of service and power quality are enhanced by proximity to the customer and efficiency is improved in on-site applications by using the heat from power generation.

The Distributed Generation Program contributes to two of the energy challenges that are being addressed in the National Energy Strategy: (1) "Improving the environmental acceptability of energy production and use by improving the efficiency and economics of the use of natural gas through the use of advanced technologies," and (2) "increasing the competitiveness and reliability of U.S. energy systems." This is achieved through the strategy of encouraging the development and deployment of distributed power technologies to satisfy market forces for smaller, modular power technologies that can be installed quickly, close to consumer demand centers.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Coal and Other Power Systems program supports the following goal:

Energy Strategic Goal

General Goal 4: Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Coal and Other Power Systems program has one program goal which contributes to General Goal 4 in the "goal cascade".

Program Goal 04.55.00.00: Create public/private partnerships to provide technology to ensure continued electricity production from the extensive U.S. fossil fuel resource, including control technologies to permit reasonable-cost compliance with emerging regulations, and ultimately, by 2015, zero emission plants (including carbon) that are fuel-flexible, and capable of multi-product output and efficiencies over 60 percent with coal and 75 percent with natural gas.

Contribution to Program Goal 04.55.00.00 (Zero Emissions Coal-Based Electricity and Hydrogen Production)

- The Clean Coal Power Initiative subprogram will develop advanced coal-based power generation technologies that: improve efficiency from 2002 baseline by 40-50 percent by 2010, with environmental and economic performance capable of achieving 90 percent Hg removal at a cost of 70 percent of current technology by 2010, 0.15 lb/MMBtu NO_x at 75 percent of the cost of current technology (selective catalytic reactors), and lower capital costs for gasification technologies from \$1200 per kilowatt of capacity; co-produce heat, fuels, chemicals or other useful byproducts; and, provide a deployment-ready suite of advanced technologies that can produce substantial near-, mid-, and long-range economic and environmental public benefits.
- The FutureGen research prototype facility, within the Clean Coal Power Initiative subprogram, will prove the technical feasibility and economic viability of the zero emissions (including carbon) coal concept.
- The Innovations for Existing Plants activity, within the Central Systems subprogram, supports the President's Clear Skies Initiative by having technologies ready for commercial demonstration by 2005 with the potential to reduce: mercury by 50-70 percent at 70 percent of today's cost of \$50,000-\$70,000/lb of mercury; NO_x to less than 0.15 lb/mmBtu at three-quarters of the cost of selective catalytic reactors (SCR), which is currently \$80-\$100/Kw; PM_{2.5} by 99.99 percent for less than \$50-\$70/Kw; and acid gases by 95 percent. By 2010, test technologies for advanced cooling, mercury

reduction by 90 percent at 70 percent of today's cost of \$50,000-\$70,000/lb. of mercury; and a 66 percent increase in byproducts utilization.

- The Advanced Power Systems activity, within the Central Systems subprogram, will develop, by 2010, advanced power systems capable of achieving 50% thermal efficiency at a capital cost of \$1000/Kw or less for a coal-based plant.
- The Fuels subprogram, by 2010, will complete development of modules capable of co-producing hydrogen from coal at \$30/barrel crude oil equivalent (no incentives or tax credits) when integrated with advanced coal power systems.
- The Advanced Research subprogram sustains U.S. preeminence in fossil fuel technology by supporting development of material, computational method, and control system knowledge needed to bridge gaps between science and advanced engineering. Advanced Research efforts will allow development, by 2010, of enabling technologies that support the goals of Vision 21 power systems.
- The Sequestration subprogram, by 2007, will demonstrate at a pilot plant scale, technologies to reduce the cost of carbon separation and capture from new coal-based power systems by 75 percent compared to current systems (\$200/tonne carbon in year 2000). By 2012, develop technologies that result in less than 10 percent increase in the cost of new energy services to separate, capture, transport, and sequester carbon using either direct or indirect systems.
- The Distributed Generation Systems subprogram, by 2010, will increase the robustness of distributed generation and thereby lower vulnerability of the electricity grid by introducing prototypes of modular fuel cells with 10-fold cost reduction (\$400/Kw) with 40-60 percent efficiency adaptable for coal.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

Program Goal 04.55.00.00 Zero Emissions Coal-Based Electricity and Hydrogen Production

Clean Coal Power Initiative

No targets reported	No targets reported	No targets reported	Complete CCPI Round 1 solicitation, proposal evaluations and project selections to assemble the initial portfolio of advanced technologies capable of improving the economic and environmental performance of coal-based electric power generation facilities.	Make go/no go decisions regarding award of cooperative agreements for up to 5 Round 1 CCPI projects and issue a Round 2 CCPI solicitation.	Initiate 100% of the active industrial projects selected under the first round of the competitive CCPI solicitation and make project selections from the second round CCPI solicitation.
			Complete NEPA process for 3 out of the 6 active PPII projects and initiate construction or operations phases for several of the projects.		
			Complete sufficient implementation activities on remaining projects to resolve any barrier issues.		
			Complete demonstration tests on the LPMeOH coal-to-methanol conversion project and provide comprehensive documentation of the system and its efficiency, economics, and environmental performance for use by industry in assessing the merit for further commercial deployment of the technology.		
Central Systems Complete pilot studies on mercury emission controls that augment existing pollution control technologies, and are	Deliver to EPA 2 years worth of high-quality PM _{2.5} ambient monitoring data from the upper Ohio River Project. (MET GOAL)	Complete Phase I report characterizing concentration and composition of ambient PM _{2.5} emissions as input to the EPA PM _{2.5} National	Initiate projects for developing technologies to address emerging electric utility/water issues and combustion byproducts	Complete bench- and pilot-scale testing of five novel mercury control concepts capable of achieving ≥90% mercury capture by 2010 and	Establish baseline data for emission, transport, and deposition of mercury from coal-fired boilers in support of Clear Skies mercury

**Fossil Energy Research and Development/
Coal and Other Power Systems**

FY 2005 Congressional Budget

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
<p>expected to reduce mercury emission by over 50 percent at less than half the cost originally estimated in EPA's December 1997 Report to Congress on Mercury. (MET GOAL)</p> <p>Complete the first large scale (600 MW) test of selective noncatalytic reduction, which will allow coal-fired power plants to satisfy ozone transport (OTAG) requirements for reduction of emissions of oxides of nitrogen and also reduce fine particulate matter. (MET GOAL)</p> <p>Complete demonstration of the third integrated gasification combined cycle project (Pinon Pine) utilizing air-blown gasification and hot gas cleanup for improved thermal efficiency, and continue operations of one other project (Polk) in order to establish the engineering foundation leading to new generation of 60 percent efficient power plants. (NEARLY MET GOAL)</p>	<p>Issue request for proposals for the commercial scale demonstration of technologies to assure the reliability of the Nation's energy supply from existing and new electric generation facilities. (MET GOAL) Demonstrate hydrogen and CO₂ separation from syngas to meet the long-term goals of providing low-cost hydrogen for high-efficiency fuel cells, and for providing concentrated CO₂ streams for sequestration. (MET GOAL)</p> <p>Complete design and continue construction of Circulating Atmospheric Fluidized Bed demonstration project at Jacksonville, Florida. (MET GOAL)</p>	<p>Ambient Air Quality Standards (NAAQS) review. This data will help identify the impact of emission sources on air quality. (MET GOAL)</p> <p>Complete initial tests of the IGCC transport gasifier to confirm the feasibility of the technology to significantly improve reliability, cost effectiveness, and efficiency for producing electricity and other products. (MET GOAL)</p>	<p>utilization and disposal.</p> <p>Complete preliminary field testing of alternative mercury control technologies representing two approaches for achieving 50% or greater removal.</p> <p>Complete fine particulate monitoring in the Upper Ohio River Valley region; complete field testing of alternative particulate matter collection technologies representing at least two approaches for achieving 99.99% removal; initiate research on PM_{2.5} and mercury transport and deposition.</p> <p>Initiate developmental testing of SCR catalysts for reducing NO_x emissions from alternatively fueled boilers.</p> <p>Establish a 1-5 tpd facility capable of determining engineering feasibility, defining technical performance, and establishing operating costs for oxygen separation using membrane technology.</p> <p>Complete initial laboratory-scale performance testing of hydrogen separation membranes using simulated gas streams.</p> <p>Complete initial laboratory tests to determine performance capabilities of sorbents, sieves, and membranes for removing mercury, sulfur, nitrogen, and</p>	<p>initiate seven new projects under second phase of field testing of mercury control technology capable of achieving 50-70% mercury capture.</p> <p>Complete Ion Transport Membrane (ITM) designs with target oxygen production of 95% purity, to obtain engineering data for further technology scale-up, ultimately leading to cost reductions of \$75-\$100/KW, and efficiency improvements of 1-2 points by 2010.</p> <p>Complete at least 250 hours of high efficiency desulfurization process units operating with coal-derived synthesis gas. Eventual process units improvements are targeted to contribute a 60-80 \$/KW capital cost reduction and a 1 point efficiency gain to the gasification system performance by 2010.</p> <p>Initiate testing on advanced hydrogen separation membranes in simulated coal gasification product streams and complete design of a hydrate pilot-scale slipstream test unit. Advanced hydrogen separation technologies target eventual sequestering of CO₂ with a less than 10% increase in electricity cost by 2012.</p> <p>Perform modeling, facility modifications, and conduct pilot-scale tests for</p>	<p>reduction component.</p> <p>Complete integrated testing of advanced synthesis gas cleaning technologies for the removal of sulfur, ammonia, chlorides, and mercury to near-zero emissions levels with a pilot-scale coal gasifier that will lead to capital cost reductions of \$60-80.kWe and efficiency improvements of >1 efficiency points.</p>

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
			CO ₂ from gas streams.	identifying technology opportunities to increase reliability, improved performance and increased feed flexibility of advanced gasifiers. Gasification improvements target eventual capital cost reductions and a 90% single train availability by 2010.	
			Conduct gasification support tests on leachability of gasifier residues, improved refractories, and oxygen-blown gasification of alternative fossil fuel feedstocks, and develop a simulator for a Vision 21 plant.		
			Develop technical and cost information sufficient for DOE decision-making on the viability of proceeding with plans for construction of a co-production plant.	Perform a thermal analysis of syngas turbine blades, initiate testing of an H ₂ delivery system, and perform a systems study of an optimized IGCC turbine design. Ultimately by 2008 these and follow-on efforts will reduce IGCC NO _x emissions to less than 3 ppm, reduce turbine cost by 10-20% by increasing specific power output, increase turbine firing temperature and combined cycle integration to improve efficiency by 2-3 percentage points and reduce emissions associated with high hydrogen fuels.	
			Complete conceptual studies to assess ATS and other machines for operation on coal syngas, as well as, ATS machines in coal and natural gas based integrated hybrid power modules, complete demonstration of a low-emission steam generator, demonstrated an integrated sensor suite for real-time monitoring of an advanced turbine's operational performance, and demonstrated in-situ single crystal bladewelding and repair techniques.		
			In the area of advanced systems initiated work on gas turbine combustor and nozzle systems for fuel flexible low-NO _x performance in IGCC applications for designs that are capable of meeting Vision 21 performance requirements.		

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
<p>Sequestration R&D Commence three to four small scale carbon sequestration development projects from those selected in the FY 1998 Novel Concepts solicitation, and initiate feasibility studies for one to two sequestration projects selected under FE's August and September 1999 solicitations. (MET GOAL)</p>	<p>For carbon sequestration, expand the number of possible cost effective, collaborative, multi-national applied R&D options carried to the "proof-of-concept" stage. Complete multiple field experiments on promising technologies. (MET GOAL)</p>	<p>Complete the injection of 2,500 tons of CO₂ into a depleted oil reservoir to monitor the transport of CO₂ and verify predictive geologic models on reservoir integrity. (NOT MET)</p>	<p>Continued technology base development in the areas of thermal barrier coatings, emission reductions, combustion stability, heat transfer and aerodynamics in turbines for coal derived synthesis gas.</p>	<p>Design and test multiple concepts for efficient, low-cost, advanced CO₂ separation and capture including on oxy-fuel combustion, membranes, and hydrates for CO₂ separation. Conduct field activities that evaluate sequestration opportunities in depleted oil reservoirs and saline aquifers. Collaboratively explore with the National Academy of Sciences novel and revolutionary means of storing greenhouse gases. This portfolio of over 22 projects targets reducing the cost of carbon dioxide separation and capture by 75% by 2012 compared to year 2000 systems.</p>	<p>Complete pilot tests on advanced capture technologies related to membrane and hydrate configurations.</p>
			<p>Establish modular carbon dioxide capture test facility. This facility will accelerate development and testing of emerging low-cost separation and capture technologies while facilitating partnerships with leading technology developers and academic institutions.</p>		
			<p>Complete initial set of field tests of advanced monitoring and verification methods for carbon inventories on natural and engineered terrestrial systems and establish a database for mid-continent planning of geological storage projects.</p>		
			<p>Initiate evaluations of three novel concepts, comprising integrated sequestration with enhanced coal bed methane recovery, mineral carbonation, and CO₂ flooding during enhanced oil recovery and establish initial recommendations for long-term monitoring of CO₂ geological storage to assure acceptability as a safe, long-term storage option.</p>		
			<p>Complete initial planning, field testing, or analyses of sequestration concepts</p>	<p>Develop instrumentation and initiate field tests of advanced monitoring and verification methods for carbon inventories for geologic and terrestrial sequestration. Complete a database for mid-continent geological storage projects and initiate a framework for U.S. wide project planning. Through regional partnerships, begin U.S.-wide infrastructure</p>	

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
			involving saline aquifer storage, ocean storage, and scientific feasibility of CO ₂ storage as hydrate on the ocean floor, and complete initial comparative evaluation of energy technology scenarios to identify promising concepts for CO ₂ sequestration.	development of MMV protocols for carbon accounting to ensure permanence of long-term storage of CO ₂ .	
Fuels No targets reported.	No targets reported.	Tests to determine ceramic membrane performance in laboratory-scale apparatus are complete. The ITM H ₂ /Syngas project has now tested five membranes, each of which has been operated for over six months at high pressure. Tests confirmed the selection of membrane materials and provided data for performance models. Additional laboratory-scale testing of catalysts and membrane stability will continue in support of pilot-scale operations and future commercialization. (MET GOAL)	Complete development and communication of a hydrogen program and implementation plans. Continue development of ITM membrane technology at reduced pace leading to the scaleup of the concept at the SEP level.	Prepare and communicate a Hydrogen from Coal R&D program strategy and develop solicitation research guidance for technology innovation to reduce the cost of producing hydrogen from coal.	Complete tests of advanced water-gas shift membrane reactor.
Advanced Research No targets reported.	No targets reported.	No targets reported.	Prepare and evaluate novel sensors and new materials for high temperature, oxidative environments to improve control, increase efficiency and performance, and/or achieve lower emissions of CO ₂ and other pollutants. Complete preparation and communication of consolidated Advanced Research program and program implementation plans that incorporate	No targets reported.	No targets reported.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
			guidance from workshops with external stakeholders.		
			Provide student and faculty training and education through selection of 8 students to participate in the undergraduate internship program for fossil energy and environmental science research and through 15 total awards under the University Coal Research and HBCU/OMI programs for research on critical needs for enabling Vision 21 power systems.		
Distributed Generation Systems Begin testing of first market prototype solid oxide fuel cell for distributed power applications. (MET GOAL) In support of Vision 21, complete testing of a 250 kw fuel cell/turbine hybrid, and deliver a conceptual design of a one MW fuel cell/turbine hybrid power plant to facilitate market entry. (MIXED RESULTS)	Begin testing of a 300 kw - 1 MW solid oxide fuel cell/turbine hybrid commercial prototype for distributed power applications (MET GOAL) Begin construction of a one MW solid oxide fuel cell (SOFC) hybrid. (NOT MET)	Complete demonstration of a commercial-scale, 250 kw molten carbonate fuel cell (MCFC) power plant system. This test will verify the commercial design for the MCFC technology for the combined heat and power (CHP) or distributed generation (DG) market and, if successful, will justify the construction of a MCFC manufacturing facility in the U.S. (MET GOAL)	Communicate fuel cell program objectives and results and conduct peer-reviews through conferences, workshops, and web-site tools. Manage the PSPG R&D portfolio through assessment of results and selection of new projects to fill portfolio gaps. Conduct field tests necessary to establish feasibility of high temperature fuel cell hybrids and novel systems, including design, procurement, construction, and testing. Conduct cost reduction R&D programs involving near-term developers, Siemens Westinghouse and Fuel Cell Energy, for the fuel cells, including manufacturing and balance of plant (BOP) components. The SECA industrial teams	Relative to FY 2003 baseline, demonstrate a 20% improvement in fuel cell stack power density for Solid State Energy Conversion Alliance (SECA) system design. Relative to FY 2003 baselines, complete 20% improvements in cathode performance and in the service life of electrical interconnect s and transfer technology advances to the SECA industry teams to facilitate systems cost reduction and efficiency goals of \$400/kW and 40-60 percent. Annual stakeholder workshops and semi-annual peer reviews will communicate progress and define future R&D requirements.	Begin prototype validation of technical requirements for low-cost SECA fuel cell systems. Test at least one prototype capable of achieving SECA cost reductions and efficiency Phase I goals. Under the SECA Core Program, validate one new sealing concept; 20% improvement in metallic interconnect performance relative to FY 2004; and 20% sulfur tolerance relative to FY 2004. These validations will aid SECA industry teams in achieving cost reduction and energy efficiency goals.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

shall conduct stack design and testing, including manufacturing approaches, and materials and balance of plant (BOP) systems optimization leading to the demonstration of prototypes.

Conduct contracted and in-house SECA core technology of crosscutting and proof-of-concept R&D for transfer to one or more industrial teams, including know-how, patents, licenses, reports, papers in peer reviewed journals, etc.

Efficiency Measure

Efficiency goal of greater than 90 percent of procurement milestones (e.g. solicitation issue date, proposal ranking deadline, signing of selection statement, Congressional notification, making awards, etc.) meeting the procurement plan metric.

Means and Strategies

The Coal and Other Power Systems program will continue to promote a strategy in power systems R&D that incorporates a focused and collaborative effort between government and industry to achieve the environmental and economic goals of the technologies. It will continue its dissemination of information and data and build on government-industry partnerships to commercialize clean coal technologies. For carbon sequestration, the program will continue to work with domestic and international partners to complete field experiments on promising options.

The Coal and Other Power Systems program will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals.

For all activities, DOE will work collaboratively with other government and industry partners, and participate cooperatively with other countries, for example, through the International Energy Agency in the Greenhouse Gas (IEAGHG) R&D Program and the Clean Coal Technology Center. Significant cost-sharing opportunities are possible through existing and new research agreements.

Program results may be affected by: world prices for competitive feedstocks and energy technologies; new and evolving environmental regulations; or any new legislation, in particular, new legislation related to CO₂ and air pollutants that affect coal and gas use. Also, industry restructuring/deregulation issues and uncertainties will continue to challenge coal use. Program results may be particularly affected by both evolutionary and revolutionary approaches to carbon sequestration.

Validation and Verification

The program and projects contained within this goal will be evaluated at the annual contractor's meeting. In addition, program benefits are estimated using macroeconomic and detailed industry-specific models. Modeling assumptions and methods are reviewed externally and the results are compared to results from other programs to determine the best application of R&D resources.

To validate and verify program performance, FE will conduct various internal and external reviews and audits. FE's programmatic activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. Each year, the Office of Engineering and Construction Management conducts external independent reviews of selected projects. In addition, various Operations/Field Offices commission external independent reviews of site baselines or portions of the baselines. Additionally, FE Headquarters senior management and Field managers conduct quarterly, in-depth reviews of cost, schedule, and scope to ensure projects are on-track and within budget.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Coal and Other Power Systems program has incorporated feedback from OMB into the FY 2005 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The Coal and Other Power Systems program had the President's Coal Research Initiative and Other Power Systems areas PART reviewed separately. In the Purpose, Strategic Planning, and Program Management sections of the PART, OMB gave the Other Power Systems relatively high scores of 80, 70, and 88 respectively while the President's Coal Research Initiative score some what lower at 60, 67, and 75 respectively. In both the FY 2004 and FY 2005 PARTs, most points have been lost in the Program Results/Accountability section.

The PART assessments found some notable improvements over the FY 2004 PARTs. These included agreement on goals and performance measures, clear purpose and demonstrated ability to articulate potential public benefits, and the improvement of the rating for the President's Coal Research Initiative from a "Results not Demonstrated" to an "Adequate".

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.55.00.00, Zero Emissions Coal-Based Electricity and Hydrogen Production					
Clean Coal Power Initiative	145,116	178,770	287,000	+108,230	+60.5%
Central Systems	91,494	89,880	64,500	-25,380	-28.2%
Sequestration R&D	39,101	40,297	49,000	+8,703	+21.6%
Fuels	30,443	31,221	16,000	-15,221	-48.8%
Advanced Research.....	32,444	38,215	30,500	-7,715	-20.2%
Distributed Generation Systems	62,034	71,113	23,000	-48,113	-67.6%
U.S./China Energy and Environmental Center	0	988	0	-988	-100.0%
Total, General Goal 4 (Coal and Other Power Systems).....	400,622	450,484	470,000	+19,516	+4.3%

Clean Coal Power Initiative

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Clean Coal Power Initiative					
Clean Coal Power Initiative/FutureGen	145,116	169,881	287,000	+117,119	+68.9%
FutureGen ¹	0	8,889	(237,000)	(+228,111)	(+2566%)
Total, Clean Coal Power Initiative.....	145,116	178,770	287,000	+108,230	+60.5%

Description

The mission of the Clean Coal Power Initiative (CCPI) is to enable and accelerate deployment of advanced technologies to ensure that the United States has clean, reliable, and affordable electricity. The CCPI is a cost-shared partnership between the government and industry to research, develop and demonstrate advanced coal-based power generation technologies (the most advanced example of which will be FutureGen). The mission of the FutureGen project is to establish the capability and feasibility of co-producing electricity and hydrogen from coal with essentially zero emissions, including carbon (sequestration).

Benefits

The Clean Coal Power Initiative subprogram will develop advanced coal-based power generation technologies that: improve efficiency from 2002 baseline by 40-50 percent by 2010, with environmental and economic performance capable of achieving 90 percent Hg removal at a cost of 70 percent of current technology by 2010, 0.15 lb/MMBtu NO_x at 75 percent of the cost of current technology (selective catalytic reactors), and lower capital costs for gasification technologies from \$1200 per kilowatt of capacity; co-produce heat, fuels, chemicals or other useful byproducts; and, provide a deployment-ready suite of advanced technologies that can produce substantial near-, mid-, and long-range economic and environmental public benefits. The CCPI subprogram will create public/private partnerships to provide technology to ensure continued electricity production from the extensive U.S. fossil fuel resource, including control technologies to permit reasonable-cost compliance with emerging regulations, and ultimately, by 2015, zero emission plants (including carbon) that are fuel-flexible, and capable of multi-product output and efficiencies over 60 percent with coal.

The FutureGen project will establish the capability and feasibility of co-producing electricity and hydrogen from coal with essentially zero emissions. The project is critical to the continued and expanded use of our most abundant and lowest cost domestic energy resource, coal. FutureGen will require integration of components yet to be developed, such as low cost CO₂ capture and storage technology, and thus involves considerable risk. However, the public benefits when we succeed will be

¹ Funding for FutureGen was appropriated separately in FY 2004. The FY 2005 Budget includes FutureGen under the Clean Coal Power Initiative.

enormous. In order to assure that FutureGen is successful, it will be supported by a clean coal R&D effort focused on all the key technologies needed - such as carbon sequestration, membrane technologies for oxygen and hydrogen separation, advanced turbines, fuel cells, coal to hydrogen conversion, gasifier related technologies, and other technologies, funding for which is included in the Administrations FY 2005 budget request. CCPI demonstrations directly support the FutureGen project by driving down the costs of IGCC systems and other technologies whose extensions are critical to the success of FutureGen.

Coal is the most abundant U.S. energy resource, with domestic reserves exceeding the energy potential of the world's oil reserves. About 90% of all coal produced in the U.S. is used for electricity generation, and over half of our Nation's electricity is produced by coal-fired power plants. Meeting our Nation's rising demands for clean, reliable, and affordable electricity will require the use of coal for the foreseeable future. We must therefore develop and demonstrate technologies that will enable the continued use of coal to meet our growing demand for electricity in an environmentally sound manner.

The Bush Administration is advancing its new vision in clean coal research. The Clean Coal Power Initiative (CCPI) is an effort within the Department of Energy's Fossil Energy program that combines industry investments in research and development with federal matching funds for research, development and demonstration of advanced technologies on coal-fired power plants. The Administration is requesting \$50 million in FY 2005 to fund joint government-industry-funded projects on new technologies that can enhance the reliability, efficiency, and environmental performance of coal-fired power generators. This FY 2005 funding will support the second round of projects under the Clean Coal Power Initiative, incorporating the latest advances in clean coal technologies. The CCPI responds to the National Energy Policy call to address the reliability and affordability of the Nation's electricity supply, particularly from its coal based generation, and is a key component of the President's commitment to research and development of clean coal technologies to meet this challenge. By enabling advanced technology to overcome technical risks and bringing them to the point of commercial readiness, the CCPI facilitates the movement of technologies into the market place that are emerging from the core research and development activities and directly responds to President's Clear Skies Initiative and Global Climate Change Initiative to reduce emissions of air pollutants (particularly NO_x and mercury) and carbon dioxide.

In FY 2003, the first round of CCPI projects commenced and NEPA was initiated including the conduct of public scoping meetings for three of the projects that will require Environmental Impact Statements. NEPA was completed for four of six Power Plant Improvement Initiative (PPII) projects and those projects are under construction or in operation. In FY 2004, the CCPI projects selected in the first round will be underway and sufficient CCPI funding exists to support a solicitation for a second round of projects. FY 2005 funding will enable the second round of CCPI projects to be awarded.

Detailed Program Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
▪ Clean Coal Power Initiative/FutureGen	143,626	168,181	284,130

For FY 2005, in support of the President's Coal Research Initiative, continue the Clean Coal Power Initiative (CCPI) to research, develop, and bring to commercial readiness advanced clean coal-based technologies that enhance electricity reliability, increase generation capacity, and provide clean, affordable power. Provide additional funding, complete evaluation of project applications and make project selections, and initiate negotiations with the second round of projects under the CCPI. For projects selected under the first solicitation, initiate operation for two projects, Neuco's plant-wide optimization system employing neural networks and the TOXECON sorbent injection system project for multi-pollutant control. Great River Energy will continue operation and four additional projects will initiate or continue construction activities. *Participants include: University of Kentucky Research Foundation, Neuco, Inc., Great River Energy, Western Greenbrier Co-Generation, LLC, Waste Management Processors Inc., PTY, LLC, Colorado Springs Utilities, and Wisconsin Electric Power Company. Additional participants will be determined based on results of the second competitive solicitation.*

For FY 2005, the Budget includes \$237 million for the FutureGen project, as part of a total Federal contribution to FutureGen of \$500 million, excluding related research. With the FY 2004 appropriation of \$9 million, a total of \$246 million will have been provided for FutureGen through 2005. In addition, in FY 2005 the Department will continue NEPA activities for the FutureGen project. Permitting activities will be initiated during FY2005 and must be completed before start of construction. Ordinarily, only a few permits (e.g., air, water, construction) require long lead times and/or public hearings. However, a large project such as FutureGen will require many state and local permits, and their issuance will therefore be staggered between FY 2005 and FY 2006. Site monitoring and characterization will be initiated during FY 2005. Information gleaned from design/engineering studies will be incorporated into detailed design activities, as appropriate. Typically, baseline environmental monitoring data must be gathered to support not only NEPA and Permitting activities, but also Design/Engineering. Candidate technologies will be considered and evaluated. Options will be considered in terms of success potential and leading edge characteristics. Preliminary design activity will include conceptual design of the plant's power train, air separation units, turbine and steam cycles and other generic balance of plant auxiliary systems. *Participants include:TBD.*

For FY 2005, within the Power Plant Improvement Initiative (PPII) program, complete four of six active projects including: Tampa Electric's Neural Network-Sootblower Optimization project; Sunflower Electric's optimized control system project; Universal Aggregates' ash utilization project; and Otter Tails' advanced particulate collector demonstration. Initiate operation for CONSOL Energy's multi-pollutant Circulating Dry Scrubber system and TIAX's advanced hybrid system for NO_x control. *Participants include: Otter Tail Power Corp. with UNDEERC and W. L. Gore & Associates, Tampa Electric Co., Universal Aggregates, LLC, Sunflower Electric Power Corp., CONSOL Energy, Inc., and TIAX, LLC.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

For FY 2004, within the Clean Coal Power Initiative (CCPI) program, provide funding to support issuing a second solicitation leading to expanding the portfolio of demonstration projects. Award remaining projects from the first solicitation and begin operation of Great River Energy's coal-dryer system for high-moisture lignite and Powder River Basin (PRB) coals. Complete National Environmental Policy Act (NEPA) requirements and initiate construction activities for four projects and continue design activities for three projects. *Participants included: University of Kentucky Research Foundation, Neuco, Inc., Great River Energy, Western Greenbrier Co-Generation, LLC, LG&E Energy Corp; Waste Management Processors, Inc., PTY, LLC, Colorado Springs Utilities, and Wisconsin Electric Power Company.*

For FY 2004, within the Power Plant Improvement Initiative (PPII) program, initiate operation for Tampa Electric's Neural Network-Sootblower Optimization project; Sunflower Electric's optimized control systems project; and Universal Aggregates' ash utilization project to produce lightweight aggregate. Continue demonstration testing of the Advanced Hybrid Particulate Collector at Otter Tail Power's Big Stone Station. Complete National Environmental Policy Act (NEPA) activities and initiate construction of CONSOL Energy's multi-pollutant Circulating Dry Scrubber system and TIAX's advanced hybrid system for NO_x control. *Participants include: Otter Tail Power Corp. with UNDEERC and W. L. Gore & Associates, Tampa Electric Co., Universal Aggregates, LLC, Sunflower Electric Power Corp., CONSOL Energy, Inc., and TIAX, LLC.*

For FY 2003, initiated negotiation activities for eight project selections from the first CCPI solicitation. One project withdrew from negotiations. Initiated NEPA activities on all projects including conduct of the public scoping meetings for the three projects will be require the preparation of Environmental Impact Statements. Began planning activities for the second solicitation. *Participants included: University of Kentucky Research Foundation, Neuco., Inc., Great River Energy, Western Greenbrier Co-Generation, LLC, LG&E Energy Corp; Waste Management Processors, Inc., PTY, LLC, Colorado Springs Utilities, and Wisconsin Electric Power Company.*

For FY 2003, within the Power Plant Improvement Initiative (PPII) program, awarded Cooperative Agreements for two projects, bringing the total awarded to four out of six active projects. National Environmental Policy Act (NEPA) activities were completed for all awarded projects. Began test operations on the Advanced Hybrid Particulate Collector, installed sensor equipment for the Sunflower combustor optimization project, and installed advanced soot-blowing equipment for the Tampa Electric project. Initiated construction of the processing facility for the Universal Aggregates project that will convert spray-dryer ash into lightweight aggregate for masonry or concrete. *Participants include: Otter Tail Power Corp. with UNDEERC and W. L. Gore & Associates, Tampa Electric Co., Universal Aggregates, LLC, Sunflower Electric Power Corp., CONSOL Energy, Inc., and TIAX, LLC.*

▪ **FutureGen** 0 8,889 (237,000)

For FY 2005, activities will continue under the Clean Coal Power Initiative described above.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

For FY 2004, the NEPA process will be initiated along with the conceptual plant design. Assessments of the availability of key cutting edge technologies will be conducted. Analyses will be conducted to establish critical site requirements. Detailed project schedules and competitive procurement plans for key components and technologies will be developed.

Participants include: TBD.

▪ Program Support	1,490	1,700	2,870
Fund technical and program management support.			
Total, Clean Coal Power Initiative	145,116	178,770	287,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

• Increase in the Clean Coal Power Initiative/FutureGen program will create a public/private partnership to prove out technology ultimately leading to zero emission plants; includes FY 2004 funding for FutureGen and associated technical and program support funds.....	+108,230
Total Funding Change, Clean Coal Power Initiative	+108,230

Central Systems

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Central Systems					
Innovations for Existing Plants	21,566	21,729	18,050	-3,679	-16.9%
Advanced Systems	69,928	68,151	46,450	-21,701	-31.8%
Total, Central Systems	91,494	89,880	64,500	-25,380	-28.2%

Description

As part of the President's Coal Research Initiative, FutureGen is a Presidential Initiative to create an advanced, full-scale integrated facility that will utilize advanced coal gasification technology to produce electric power and hydrogen while capturing and sequestering carbon dioxide. The Central Systems Programs is to provide critical research for FutureGen to dramatically reduce coal power plant emissions and significantly improve efficiency to reduce carbon emissions.

Benefits

The Central Systems subprogram supports DOE's overarching mission to advance national energy security in an economic and environmentally sound manner by developing a cost-effective, high-efficient technological capability to eliminate environmental concerns associated with coal use. In the near term this means having the ability to meet all existing and anticipated environmental regulations at low cost. In the longer term, the aim is to nearly double coal power plant efficiencies (from 33% to 60%) at affordable costs of electricity while working towards zero emissions, allowing coal to remain a key strategic fuel for the Nation. The program mission is carried out in support of several key Presidential initiatives including the Coal Research Initiative, Clear Skies Initiative, Global Climate Change Initiative, and the FutureGen Initiative.

Background

The National Energy Policy recommends that the Department continue to develop advanced clean coal technology with a goal of deploying high efficiency coal power plants achieving zero emissions. Further, the President's Clear Skies Initiative is supported by the development of advanced emission control technology and related byproducts and water research as part of the research portfolio under Central Systems. The President's Climate Change Initiative over the longer term is supported through technology for advanced power plants that can nearly double the average efficiency of today's fleet of coal power plants, thereby significantly reducing carbon emissions. The growing national economy relies increasingly on electricity supply that is secure, affordable, and reliable. This is especially true in the face of concerns over national energy security as well as electricity generation market restructuring. In addition, compliance with more stringent environmental regulations

requires reduced emissions from electric power plants. Further, new technology is needed to develop much cleaner and more efficient plants to replace and augment an aging power generation infrastructure. Electricity demand from both natural gas and coal is projected to increase significantly through the year 2015 to meet increased energy demand in the U.S. (Annual Energy Outlook, 2003).

The program elements for Central Systems include technology developed for existing plants, advanced systems, FutureGen and Vision 21 are as follows:

- **Innovations for Existing Plants (IEP)** - The IEP program element has a near-to-mid term focus on improving overall power plant efficiency (thereby reducing carbon emission) and developing advanced cost-effective environmental control technologies for retrofitting to existing powerplants and other coal technologies including those developed in support of the FutureGen initiative such as Integrated Gasification Combined Cycle. The research is also directed at the environmentally sound use and disposal of coal byproducts and at novel systems and technologies to minimize the impact of electricity production on water availability and quality. The IEP program directly supports the goals and objectives of the President's February 14, 2002 Clear Skies Initiative that calls for substantial reductions in mercury, NO_x, and SO₂ emissions from power plants. Results of this advanced research are used by those who develop, design, manufacture and operate both existing and advanced systems across the entire spectrum of coal utilization technologies not only to improve efficiencies, but also to improve environmental performance. This program's crosscutting efforts address the cost-effective removal of pollutant causing contaminants from fossil fueled systems while maximizing the efficient recycling of all by products.
- **Integrated Gasification Combined Cycle (IGCC)** - The IGCC program supports both the President's Clear Skies Initiative and climate change goals by enhancing the thermal efficiency of converting coal to electricity, providing the potential for over 50% reduction in CO₂ compared to today's technologies, and through its performance goals of achieving near-zero emissions of SO₂, NO_x, mercury, and other pollutants. The IGCC program conducts research that fosters the development and deployment of fuel-flexible gasification-based processes for converting carbon-based feedstocks to electricity, steam, and a broad range of chemicals, including ultra-clean transportation fuels like hydrogen. In order to achieve the full potential of IGCC, significant advances must be made to reduce the capital and operating and maintenance costs and to improve both the reliability and the overall system availability. In FY 2005, the program will be more narrowly focused but will continue to develop technologies for gas stream purification to meet quality requirements for use with fuel cells and conversion processes; enhanced process efficiency; and reduced costs for producing oxygen. Development of technologies to cost effectively separate hydrogen from shifted synthesis gas and reduce gas emissions will continue at a substantially reduced level of effort. The successful accomplishment of these activities will enhance the commercialization prospects of advanced IGCC technologies for the production of electricity for use by utilities, independent power products, and other industrial stakeholders.
- **Combustion Systems** - This program was redirected in prior years to support advanced combustion hybrid concepts for Vision 21. In FY 2005, specific technologies from this category are included in the Gasification activity to enhance the integration of hybrid combustion/gasification concepts, including support for the test activity at the Wilsonville Power Systems Development Facility (PSDF).

- Turbines - The Turbines Program is designed to enable the low cost implementation of the President's Climate Change, Clear Skies, and FutureGen initiatives. The focus is on developing enabling technology for high efficiency hydrogen syngas turbines for advance gasification systems that can be deployed in the near-term at \$1000/kW, and for hydrogen turbines that will permit the design of zero emission FutureGen plants with carbon capture and sequestration. The focus is on key technologies needed to enable the development of advanced turbines that will operate with zero emissions, and higher efficiency when fueled with coal derived synthesis gas and hydrogen fuels. Developing turbines with superior performance that operate on coal derived synthesis gas and hydrogen is critical to the deployment of advanced power generation technologies such as integrated gasification combined cycle and FutureGen plants. The Turbine Program is an investment in secure U.S. electric power production which is clean, efficient, affordable and is fuel-flexible. These advances in turbine technology will make possible the continued use of coal, our Nation's largest domestic fossil energy resource.

During FY 2003, DOE completed the concept studies to run ATS and other machines on coal syngas, as well as ATS machines in coal and natural gas based integrated hybrid power modules, demonstrated the Clean Energy Systems 10MW low-emission steam generator, demonstrated an integrated sensor suite for real-time monitoring of an advanced turbine's operational performance, and demonstrated in-situ single crystal blade welding and repair techniques. In FY 2004, the R&D will focus on combustor performance and design using coal derived syngas, models/simulation tools for low-emission combustion systems, and tools that can predict reliability, availability, and maintainability. In FY 2005, hybrids activities will focus on the continued development of sub-MW scale SECA fuel cell turbine hybrids, hybrids advanced cycles and component development, and systems and cost studies of advance zero emissions and/or hybrid systems. Additionally, work will be done through the University Turbine Systems Research Consortium to initiate studies concerning aerodynamics, materials, heat transfer and combustion for advanced hybrid systems. NETL will initiate the operation of a fuel cell/turbine hybrid simulation facility (HYPER Project). The hydrogen turbine work will include the initiation of work done through the University Turbine Systems Research Consortium targeted to resolve basic turbine issues associated with materials, combustion, and aero-thermal sciences that are applicable to hydrogen turbines in gasification. Work conducted at NETL will focus on performance validations of simulation of hydrogen combustor, measurements of flame electrical impedance in a full-scale combustor and development of test combustor concepts for syngas testing. Work at GE will be refocused to develop new methodology for advanced sensors and controls for coal/IGCC, and demonstrate the methodology in operating coal/IGCC power plants. Work initiated in FY 2004 with BBFA awards will continue on syngas combustion and cycle improvements a new designs for hydrogen turbines components with increased efficiencies and reduced emissions.

Vision 21 is a long-term concept, the ultimate manifestation of which is the FutureGen project. The Vision 21 concept will lead to the development of technologies that convert a combination of feedstocks (e.g., coal, natural gas, biomass, and opportunity fuels such as petroleum coke or heavy oil resid (refinery wastes) to electricity, heat (e.g., steam), and a suite of high-value products that may include synthesis gas, hydrogen, chemicals, and saleable by-products (e.g., sulfur and ash or slag). Research and development continues on key enabling technologies, supporting R&D, and systems analyses, simulations and integration through the

government/industry/laboratory/university cost-shared partnership based on the gasification route in the Vision 21 technology roadmap.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Innovations for Existing Plants 21,566 21,729 18,050

The FY 2005 request emphasizes field testing and evaluation of retrofit mercury technology. In addition, research will be carried out in the development of NO_x, and acid gas (SO₃, HCl, and HF) control technologies, as well as in mercury emission, transport, and deposition assessment, technological solutions to emerging energy-water issues, determining PM_{2.5} source-receptor relationships as they relate to coal-fired power plant emissions and human health, and environmental characterization of coal-combustion and gasification and other advanced power system byproducts. This research directly supports the goals of both the President's Clear Skies and FutureGen initiatives.

▪ **Super Clean Systems 1,485 1,466 1,485**

In FY 2005, Super Clean Systems research focuses on reducing nitrogen oxide (NO_x) emissions from coal-based power plants in direct support of the Clear Skies Initiative. Work will continue on development of ultra low-NO_x combustor for integrated gasification combined cycle systems resulting from FY 2002 Broad Based solicitation. Research will also continue under FY 2004 targeted solicitation to develop advanced combustion NO_x control technology, novel catalysts and non-ammonia reagents for SCR systems, and advanced Asmart systems® to achieve a mid-term (2010) emission target of <0.10 lbs/mmBtu and a long-term (2020) target of <0.01 lbs/mmBtu. *Participants include: Argonne National Lab, Precision Combustion, TBD.*

In FY 2004, Super Clean Systems research focuses on reducing emissions of primary oxides associated with NO_x and SO_x pollution in support of the Clear Skies Initiative. The work will complete Ultra-low NO_x Burner development, and continue development and pilot-scale testing of novel NO_x control technology concepts selected under the FY 2002 Broad Based Solicitation and under an FY 2003 targeted solicitation. *Participants include: Argonne National Lab, GTI, Praxair, Wiley, Precision Combustion, TBD.*

FY 2003 funding continued development of ultra-low NO_x combustion systems, oxygen-enhanced combustion, Methane-deNO_x technology, and approaches to controlling NO_x in cyclone boilers.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

▪ **Fine Particulate Control/Air Toxics** **14,217** **13,689** **9,949**

In FY 2005, focus on continuation of Phase II field testing of advanced mercury control technologies selected under FY 2003 targeted solicitation capable of achieving 50-70% mercury removal in direct support of Clear Skies Initiative, including a second round of awards made in late FY 2004. Research directed at lower-rank coals and balance-of-plant issues. Complete pilot-scale testing of novel mercury/multi-pollutant control concepts capable of >90% mercury capture. Complete mercury, trace metal, and fine particulate transport and deposition model for upper Ohio River valley region. Continue assessment of relationship between emissions from coal-fired power plants and human health. Continue study of mercury emission, transport, and deposition as it relates to local hot spots and global mercury inventory. Initiate acid gas control technology research. *Participants include: Brookhaven National Lab, Argonne National Lab, Lawrence Berkley National Lab, ATS, SRI, University of Utah, TVA, TBD.*

FY 2004, In support of Clear Skies Initiative, continue Phase II field testing of advanced mercury control technologies to achieve 50-70% mercury removal directed at lower rank coals and balance-of-plant issues. Continue bench- and pilot-scale development of novel technology to achieve 90%+ mercury capture. Develop fine particulate and acid gas control and sensor technology selected under FY 2002 solicitation. Continue with more comprehensive modeling assessment of fine particulate and mercury source-receptor relationships. Continue projects selected in FY 2003 to address energy-water issues. *Participants include: Brookhaven National Lab, Argonne National Lab, Lawrence Berkley National Lab, ATS, CONSOL, URS, CMU, SRI, Powerspan, Apogee, TVA, UMD, BNL, LBL, RBD.*

FY 2003 funding continued field testing of two advanced mercury control technologies - sorbent injection and wet-FGD enhancement - to achieve 50-70% mercury control and continued pilot-scale development of six novel mercury control concepts capable of achieving +90% control. Completed pilot-scale development and testing of additives to improve fine particulate capture in ESPs, alkaline injection for controlling acid gas emissions, and an advanced fine particle separation technology. Completed collection of ambient PM_{2.5} samples from the upper Ohio River Valley region. Initiated development of on-line continuous SO₃ analyzer and study of in-plume mercury reactions. *Participants included: ATS, LSR, CONSOL, ADA-ES, MTI, Southern Research Institute, CMU, URS, UNDEERC, Apogee, REI, Powerspan, GE-EERC, BNL, ANL, TVA..*

▪ **In-House.....** **3,663** **3,911** **3,960**

In FY 2005, continue development of novel mercury control concepts and mercury emission characterization using 500 lb/hour combustion unit. Continue CFD modeling of mercury emission and control, issue analysis, by-product characterization, and water-related research in support of FutureGen and Clear Skies. Provide for customer service and business activities. *Participants include: NETL.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

FY 2004, Research and systems analysis was conducted on novel multi-pollutant control, mercury control and characterization, by-product characterization, and water-related issues in support of zero-emissions for FutureGen and Clear Skies. Provide for customer service and business activities.

Participants include: NETL.

FY 2003 funding continued development of mercury control technologies and characterization of mercury emissions in 500 lb/hour combustor and collection of ambient PM_{2.5} data from Pittsburgh campus monitoring site. Initiate computational fluid dynamic (CFD) modeling of mercury emission and control. Continued evaluation of mercury and other metal leachates from coal combustion byproducts.

Participants included: NETL.

▪ Waste Management	1,980	2,445	2,475
---------------------------------	--------------	--------------	--------------

In FY 2005, assess potential environmental impacts of coal combustion and advanced combustion/gasification byproducts and solid residues, focusing on mercury and other trace metals, in support of both FutureGen and Clear Skies. Continue characterization of coal byproducts from Phase II mercury control technology field testing initiated under FY 2004 targeted solicitation. Conduct joint industry/government R&D activities to maximize recycle use of coal utilization byproducts for various market applications, and facilitate technology transfer. Complete development of byproduct treatment and separation technology selected under FY 2003 Broad Based solicitation. Continue advanced concepts and technologies selected under the FY 2003 targeted solicitation to manage power plant water use. *Participants include: Argonne National Lab, WVU, PPL, UNDEERC, University of Kentucky.*

FY 2004, Continue assessment of environmental impacts of coal combustion and gasification byproducts and solid residues, focusing on mercury and other trace metals. Conduct joint industry/government R&D activities to maximize recycle use of coal utilization byproducts for various market applications, and facilitate technology transfer. Continue development of byproduct treatment and separation technology selected under FY 2003 Broad Based solicitation. Initiate projects selected under the FY 2003 targeted solicitation to maximize water utilization efficiency with minimal environmental impact. *Participants include: WVU, PPL, UNDEERC.*

FY 2003 funding continued development of ozone-based unburned carbon separation technology and evaluation of mercury leaching and volatilization from coal byproducts. Initiated assessment of coal drying technology to reduce cooling water makeup requirements. Continued development of high-volume applications for coal byproducts. *Participants included: University of Kentucky, PPL Generation, EPRI, UNDEERC, Lehigh University, CONSOL, WVU.*

▪ Vision 21.....	0	0	0
-------------------------	----------	----------	----------

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Beginning in FY 2003 and continuing in FY 2004 and FY 2005, activities that are focused on efficiency issues are addressed under the Advanced Research Materials program.

▪ Program Support	221	218	181
--------------------------------	------------	------------	------------

Fund technical and program management support.

Advanced Systems	69,928	68,151	46,450
-------------------------------	---------------	---------------	---------------

Advanced Systems focus on the development of critical enabling technologies and systems for new, cost-competitive plants with increasingly higher efficiencies and inherent ultra-low emissions that support the President's Clear Skies and Global Climate Change, and FutureGen initiatives, leading ultimately to near-zero emission Vision 21 power plants compatible with carbon sequestration.

Integrated Gasification Combined Cycle	43,301	50,372	34,450
---	---------------	---------------	---------------

▪ Gasification Systems Technology	20,352	29,334	15,305
--	---------------	---------------	---------------

Gasification: In FY 2005, the primary focus of the Power Systems Development Unit (PSDF) will be on preparation of the facility for testing advanced Vision 21 modules while continuing to characterize the operation of the oxygen-blown transport gasifier on a range of coal feedstocks including lignite. Validation of the CFD model for the transport gasifier will continue using performance data from the PSDF, the Transport Reactor Development Unit (TRDU), and the cold model at NETL.

Gas Cleaning/Conditioning: In FY 2005, R&D will focus on achieving near-zero emissions from gasification-based systems. Operation of the Gas Process Development Unit for obtaining scale-up data for the design of transport desulfurizer using the RT13 sorbent at moderate temperatures will be completed. Validation of the transport desulfurizer CFD model will be completed using performance data from the GPDU and integrated testing with a 2.5 ton/day pilot-scale coal gasifier. Continue R&D to develop advanced concepts for removing mercury, ammonia, and chlorides to near-zero levels suitable for use in fuel cell and synthesis gas conversion applications. Construction of a skid-mounted unit of the Selective Catalytic Oxidation of Hydrogen Sulfide (SCOHS) process will be initiated. A go/no decision on field testing of the Single-step Sulfur Reduction Process (SSRP) will be made based on prior experimental and economic performance. *Participants include: SCS, NETL, UNDEERC, Fluent, RTI.*

Gasification: In FY 2004, continue to develop and test the oxygen-blown transport gasifier and associated particulate control devices at the PSDF to reduce cost and improve reliability of gasifier technology. Primary focus at the PSDF will be on oxygen-blown operations to provide options for producing hydrogen and capturing CO₂ and multi-fuel capability to enhance the applicability of the technology. Validate the oxygen-blown transport gasifier CFD model using data generated from the

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

PSDF and the Transport Reactor Development Unit (TRDU) using various coal feedstocks. Utilize the TRDU to pre-screen coal feedstocks, alternative feed systems, and process conditions to provide guidance for testing at the PSDF. Develop advanced materials for refractories and thermocouples to improve refractory performance and improve gasifier reliability. Test prototype refractory bricks in a commercial coal gasifier to demonstrate performance under actual operating conditions, and begin to install a novel high temperature measurement device to demonstrate improved gasifier performance and process control. Continue development of other advanced technologies such as burner flame monitoring, refractory wear monitoring, diffusion coatings, etc. to improve the reliability, availability, and performance of gasifiers. Investigate fundamental pre-competitive technology issues and needs to improve gasification process performance and reliability through the Gasification Technology Research Consortium.

Gas Cleaning/Conditioning: In FY 2004, efforts are directed to obtaining near-zero emissions from gasification based systems including construction of a gas cleanup module at PSDF to pave the way for Vision 21 testing of advanced modules for carbon capture and near-zero emission gas cleaning technologies. Development of advanced sorbents for achieving ultra-low sulfur levels of all contaminants at moderate temperatures. Operate the Gas Process Development Unit=s (GPDU) using the RT13 sorbent at moderate temperatures in the transport mode to provide design data for scale-up of the technology. Continue validation of the transport desulfurizer CFD model using data from the GPDU and data generated in a pilot-scale test facility integrated with a coal gasifier. Develop the novel Selective Catalytic Oxidation of Hydrogen Sulfide (SCOHS) technology and begin bench-scale evaluations for proof-of-concept testing of the technology to demonstrate ultra-low sulfur emissions at reduced cleanup costs. *Participants include: SCS, NETL, UNDEERC, Fluent, RTI, Albany, ChevronTexaco, VPI, FluoreScience, IET, GTI, GEC, MSE, SRI, and Comb Spec.*

In FY 2003, the transport gasifier and associated particulate control devices will be further developed under oxygen-blown conditions at the PDSF. The TRDU will pre-screen coal feedstocks and process conditions for testing at the PDSF. Bituminous coals will be processed at the PSDF to determine the applicability of the gasifier for high rank coals. A new dry coal feed system will be evaluated to reduce cost and improve performance over conventional lock hopper feed systems. Performance of new refractory bricks under simulated gasifier conditions will be evaluated, and if successful, bricks will be installed in high wear areas of Eastman Chemicals= coal gasifier in Kingsport, TN. Development of technologies to improve the reliability, availability, and performance of gasifiers will continue with testing of one high-temperature measurement device on the TECO IGCC gasifier. The Gas Process Development Facility (GPDU) will be operated using the EXSO3 sorbent developed previously for hot gas desulfurization and will transition to lower temperature operations to support the scale-up of the RT13 sorbent. Development of the Selective Catalytic Oxidation of Hydrogen Sulfide (SCOHS) process will continue to confirm process performance at the laboratory scale in preparation for future

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

bench-scale testing.

▪ **Systems Analysis/Product Integration..... 2,843 3,912 4,000**

In FY 2005, work will continue on assessing the economics of advanced Vision 21 process concepts and establishing performance targets for novel process concepts in the R&D program. Work at the PSDF will focus on developing integration strategies for advanced process concepts and developing experimental programs, cost, and schedules for testing the various technologies. The final reports on the final phases of the Early Entrance Coproduction Plant project for the production of electricity, fuels, and hydrogen will be prepared. Engineering support will be provided as needed for the development and evaluation of the FutureGen project. The update of the worldwide gasification database with the latest plant project announcements will be completed. *Participants include: NETL, CTC, E2S, Mitretek, SCS, ChevronTexaco, GE, Praxair, Parsons, GTC.*

In FY 2004, complete engineering designs of Early Entrance Coproduction Plants for clean fuels like hydrogen and high efficiency power productions as pre-Vision 21 concepts. Continue systems analyses for research guidance and product outreach activities. Update the worldwide gasification database. Establish size of standardized IGCC plants from market analysis and begin design of modular unit to reduce plant cost, shorten plant startup schedule, and improve system reliability. *Participants include: NETL, CTC, E2S, Mitretek, SFA, Pacific, Texaco, Parsons, WMPI, GE, KBR, Praxair.*

In FY 2003, work is continuing on risk mitigation for the Early Entrance Co-production Plants and the results were used to update the preliminary process design and analysis. The co-production design optimization study is being completed and a comprehensive report will be issued. Systems studies are being conducted to evaluate the cost and performance improvements of all technologies being developed and will be used to develop a comprehensive program roadmap. The biannual update of the world-wide gasification database was performed. *Participants included: NETL, CTC, E2S, Mitretek, SFA Pacific, ChevronTexaco, Parsons, WMPI, GE, KBR, Praxair, Global Energy, Dow Corning, Dow Chemical, Siemens Westinghouse, Methanex, Nexant.*

• **Vision 21 19,662 16,622 14,800**

In FY 2005, efforts will focus on the development of novel technologies that lead to ultra-high efficiencies, the production of hydrogen for ultra-clean fuels, and the elimination of all environmental issues that present barriers to the continued use of coal, including reductions of SO₂, NO_x, CO₂ particulates, and trace elements such as mercury, arsenic, cadmium, and selenium. Laboratory testing of improved materials for membrane-based air separation technologies and life testing of commercial membrane elements will be completed. The design of a 25-50 ton/day air separation module for integrated testing with a gas turbine and coal gasifier to address overall system performance and integration issues will begin. Development of novel process concepts for the production of hydrogen and

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

the capture of CO₂ for sequestration will continue at a minimal level. Work on developing improved membranes for hydrogen/ CO₂ separation will continue with focus on developing and optimizing the membrane fabrication process and addressing performance characteristics under actual process conditions. Continue fabrication of a skid-mounted process unit to demonstrate they hydrate process for separation of hydrogen and CO₂ from shifted synthesis gas. Testing of an advanced polymer membrane that removes CO₂, and H₂S from either a raw or shifted synthesis gas stream in conjunction with a pilot-scale coal gasifier will be completed. Complete a 500 hour integrated test of the transport desulfurizer, the direct sulfur reduction process, and advanced technologies for the removal of mercury, ammonia, and chlorides in conjunction with a 2.5 ton/day pilot-scale coal gasifier to assess technology performance on coal-derived synthesis gas. *Participants include: APCI, Praxair, ANL, Concepts NREC, Ceramatec, ChevronTexaco, PSU, Penn, Nexant, RTI, Medal, Protech, IGT, Siemens-Westinghouse, NETL, Eltron, Coorstech, Noram, Sud Chemie, SIR, KBR.*

In FY 2004, to achieve the Vision 21 program goals, develop novel technologies that lead to ultra-high efficiencies, near-zero emissions, carbon capture for sequestration and the production of hydrogen for ultra-clean fuels and powers. Scale-up and test ceramic membrane modules for advanced air separation at the 1-5 ton/day scale to reduce the cost of oxygen and pave the way for the economical capture of CO₂. Begin initial planning of 50 ton/day membrane modules for integration with a gasifier and gas turbine. Investigate improved membrane materials, fabrication techniques, and module design for H₂/CO₂ separations to address capture of CO₂ and for producing low-cost hydrogen from coal. Conduct life testing of advanced ceramic hydrogen membranes and develop conceptual process designs. Construct a polymer hydrogen membrane module for integrated testing with a pilot-scale coal gasifier to address performance under actual process conditions. Construct skid-mounted unit for the development of the low temperature hydrate technology to demonstrate effective carbon management by separating hydrogen and carbon dioxide and begin preliminary site evaluation for integration with a gasifier. Investigate advanced gas cleaning technologies to meet near-zero emission requirements in response to the Clean Skies Initiative. Begin testing of an advanced sulfur cleanup technology integrated with a pilot-scale coal gasifier to evaluate process performance under realistic conditions. Construct skid-mounted process units for mercury, ammonia, and chloride control for possible integrated testing with a pilot-scale coal gasifier. Complete conceptual design and economic analysis of a novel coal gasification concept for producing hydrogen and sequestration-ready CO₂ that has potential for cost reductions over conventional approaches. *Participants include: APCI, Praxair, ANL, Concepts NREC, Ceramatec, ChevronTexaco, PSU, Penn, Bechtel, LANL, RTI, Medal, Protech, IGT, Siemens-Westinghouse, NETL, GEERC, INT, Eltron, Coors, INEEL, Sud Chemie, SRI, ORNL, McDermott, KBR.*

In FY 2003, negotiations with ChevronTexaco will be completed on the testing of the RT13 advanced transport sorbent integrated with their pilot-scale coal gasifier. The transport desulfurizer module will be designed, constructed, and installed in preparation for a 500-1000 hour test run. Investigation of

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

ammonia, chloride, and mercury removal approaches will focus on obtaining sufficient performance and process data to design modules for integration with a pilot-scale coal gasifier. Laboratory scale testing of advanced ceramic air separation membranes will be completed to provide process design data for the 1-5 TPD engineering-scale unit and to finalize the design of the commercial-scale modules. Preliminary investigations of potential sites for integrated testing of the membrane modules with a gasifier and gas turbine will commence. Development of ceramic-based H₂/CO₂ membranes will focus on further increases in H₂ flux to achieve commercially relevant flux targets. Development of the polymer-based membrane for H₂/CO₂ separation will focus on further testing of the membrane to improve CO₂ flux and to obtain engineering data for the design of a module for integration with a pilot-scale coal gasifier. Engineering data will be obtained from a laboratory-scale flow unit for the CO₂ hydrate process to establish the design basis for a skid-mounted unit. Initial study on the feasibility of a novel gasification concept for producing hydrogen and sequestration-ready CO₂ will be completed. *Participants included: APCI, Praxair, ANL, Concepts NREC, Ceramatec, ChevronTexaco, PSU, Penn, Bechtel, LANL, RTI, Medal, Protech, IGT, Siemens-Westinghouse, NETL, REI, GEERC, INT, Eltron, Coors, INEEL, Sud Chemie, SRI, ORNL, McDermott, KBR.*

▪ Program Support	444	504	345
--------------------------------	------------	------------	------------

Fund technical and program management support.

Combustion Systems	10,097	4,939	0
---------------------------------	---------------	--------------	----------

▪ Gas Stream Cleanup	5,310	1,350	0
-----------------------------------	--------------	--------------	----------

In FY 2005, there are no activities planned.

In FY 2004, efforts are directed toward completing key cleanup projects for qualifying candle filters in pressurized applications, improving environmental control technology in CFB systems, and development of ammonia free NO_x control systems. *Participants include: Foster Wheeler, WKU Research Foundation.*

FY 2003 funding continued development of hot gas filters, a number of hot gas filter materials, certain designs validated and a broad fail safe development initiated at the PSDF. Pilot plant testing of partial gasification Vision 21 modules was undertaken and the first tests of various coal and biomass were completed, including one run oxygen in place of air. *Participants included: Southern Co.*

▪ Hybrid Combustion	4,227	3,539	0
----------------------------------	--------------	--------------	----------

In FY 2005, there are no activities planned.

In FY 2004, efforts will be focused on the development of novel technology in hybrid combustion-

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

gasification; catalytic unmixed combustion of coal; high pressure coal combustion kinetics and continuous pressure feeds for solid feedstocks to validate the engineering, economic and environmental viability to meet Vision 21 performance targets. *Participants include: Foster Wheeler, ALSTOM, GEGR, Stamet, Fluent, Inc.*

FY 2003 funding continued development of Vision 21 hybrid system enhancements and design optimization studies were undertaken as well as development of novel hybrid concepts. Two hybrid site specific repowering studies were completed and accepted by participating utilities. *Participants included: NETL, Alstom*

▪ Vision 21	457	0	0
--------------------------	------------	----------	----------

This activity was concluded in FY 2004 and folded into the gasification activity.

In FY 2003, Vision 21 combustion kinetic studies and testing were initiated and development of viable codes were undertaken. Investigations were begun into the feasibility of enabling Vision 21 combustion technologies such as chemical looping. *Participates included: Fluent.*

▪ Program Support	103	50	0
--------------------------------	------------	-----------	----------

Fund technical and program management support.

Turbines	16,530	12,840	12,000
-----------------------	---------------	---------------	---------------

▪ Vision 21	2,921	0	0
--------------------------	--------------	----------	----------

In FY 2005, funding for this activity provides for the development and deployment of syngas/hydrogen turbines for FutureGen power systems. All work in this key activity, will be conducted within the Next Generations Turbines subprogram area. Funding activities will be directed towards the reduction of NO_x emissions, efficiency improvements and technical issues associated with the combustion of high hydrogen fuels. Support for SECA based Vision 21 fuel cell hybrids will be continued under the Distributed Generation Fuel Cell Program.

In FY 2004, this activity is continued in the Next Generation Turbines subprogram described below.

In FY 2003, conducted enabling R&D for coal-based turbine systems, and initiated an accelerated effort to determine the path forward for SECA based turbine hybrids.

▪ Next Generation Turbines	13,440	12,712	11,880
---	---------------	---------------	---------------

In FY 2005, the DOE-Office of Fossil Energy will transition the Turbine Program, which is focused on the adaptation of existing advanced turbines for applications to coal derived synthesis gas, to a

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Syngas/Hydrogen Turbine Program. The Syngas/Hydrogen Turbine Program is designed to support the successful deployment of FutureGen type power systems. FutureGen plants will allow the continued use of coal our nation's largest source of fossil fuel and provide options for the capture and sequestration of carbon dioxide. This transition can be accomplished in a seamless fashion due to the similarities of technical issues associated with the combustion of coal derived synthesis gas and coal derived hydrogen. These similarities when compared to natural gas include one-third the heat content, higher flame speeds and typically higher post combustion moisture content. The lower heat content, higher flame speed and high post combustion moisture content offer significant technical challenge to develop highly efficient and clean burning combustion turbines for FutureGen applications.

The FY 2005 program will build upon work initiated in FY 2004 to address technical issues and ultimately provide turbine designs capable of burning up to 100% hydrogen in a 2008 time frame. These turbines could then be applied to FutureGen designs. The relevant technical issues are driven by the need to produce highly efficient systems with near zero emissions of NO_x emission to less than 3 ppm is being addressed through fuel pre-mixing and catalytic combustion concepts. Turbine efficiency will be addressed by optimizing F- and G-class machines for hydrogen combustion that yields higher first stage turbine inlet temperature and machines that are fully integrated with the air separation unit and steam cycle. It is expected that work to improve efficiency will address better thermal barrier coatings, better methods for blade cooling, optimizing the mass throughout and aerodynamics, and extending or realizing the full torque limitations of existing machines.

New work will be initiated to further resolve technical issues associated with the use of hydrogen fuels from FutureGen power plants. Work initiated in FY 2004 will continue as appropriate on high hydrogen fuel combustion for NO_x reduction and efficiency improvements. This work includes GE's efforts to assess premixing issues associated with high hydrogen fuels and integration issues of F-class machines in coal based plants. Work by Pratt & Whitney and Siemens Westinghouse will continue to explore catalytic combustion for NO_x reduction through the extension of the lean premix limit through hydrogen doping. Work will continue and new work initiated through the University Turbine Systems Research Consortium concerning aerodynamics, materials, heat transfer and combustion of coal derived syngas and hydrogen fuels. NETL will continue the simulation and validation of combustion phenomena associated high hydrogen content fuels. Funding for the operation of a fuel cell/turbine hybrid simulation facility (HYPER Project) will continue under the Turbine Program. *Participants include: GE, Siemens Westinghouse, Clemson-University Turbine Systems Research Consortium, NETL, TBD.*

FY 2004, the Turbine Program continues to focus on key technologies needed to enable the development of advanced turbines that will operate cleanly and efficiently when fueled with coal derived synthesis gas and high hydrogen content fuels. Developing turbine technology to operate on coal derived synthesis gas and hydrogen is critical to the development of advanced power generation technologies

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

such as integrated gasification combined cycle and deployment in FutureGen systems. Turbine R&D will focus on the adaptation of existing F- and G-class machines for application to coal-derived synthesis gas. Studies will be initiated to identify candidate technical approaches and combustion turbines for optimization/modification in IGCC systems. These studies will determine the technologies and modifications needed to meet goals for the near zero emissions, higher efficiency and machines that produce a lower cost of electricity for application to coal derived syngas and hydrogen fuels. These scoping studies will provide the direction, scope and approach for activities to follow in FY 2005-FY 2008. *Participants include: GE, SWPC, Praxair, EPRI, NETL, UTSR-SCIES, Florida Turbine Tech., ORNL, ANL, and TBD.*

In FY 2003, completed studies to assess ATS and other machines for operation on coal syngas, as well as ATS machines in coal and natural gas based integrated hybrid power modules, completed demonstration of low-emission steam generator, demonstrate an integrated sensor suite for real-time monitoring of an advanced turbine's operational performance, and demonstrated in-situ single crystal blade welding and repair techniques. *Participants included: GE, SWPC, Solar, EPRI, NETL, SCIES, U. of CA-Irvine, CFD Research, ORNL, ANL.*

▪ Program Support	169	128	120
Fund technical and program management support.			
Total, Central Systems	91,494	89,880	64,500

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Innovations for Existing Plants

▪ Decrease in Fine Particulate Control/Air Toxics funding available for projects to be selected under Round II of FY 2004 Phase II Hg Field Testing solicitation focused on low-rank coals, smaller bituminous coal units, cost and performance data, and balance-of-plant issues.....	-3,740
▪ Increase in Super Clean Systems funding available for Advanced NO _x Control Technology solicitation	+19
▪ Increase in In-House Research funding available for Hg control technology development and coal combustion byproducts characterization	+49
▪ Increase in Waste Management funding available for characterization of coal byproducts from Phase II Hg field testing projects	+30
▪ Program Support	-37
Total, Innovations for Existing Plants	-3,679

Advanced Systems

Integrated Gasification Combined Cycle (IGCC)

▪ Decrease in Gasification Systems Technology key activity will significantly reduce or terminate all projects focusing on advanced gasification concepts and improving the reliability and performance of gasifier technology through the development of advanced materials and instrumentation.....	-14,029
▪ Increase in Systems Analysis/Production Integration.....	+88
▪ Decrease in Vision 21 key activity will significantly reduce the level of effort on projects focusing on the development of advanced hydrogen/carbon dioxide separation technologies for carbon sequestration	-1,822
▪ Program Direction.....	-159
Total, Integrated Gasification Combined Cycle.....	-15,922

FY 2005 vs. FY 2004 (\$000)

Combustion Systems

▪ Decrease in Gas Stream Cleanup activities as existing projects are concluded.....	-1,350
▪ Decrease in Hybrid Combustion activities as existing projects are concluded	-3,539
▪ Program Direction.....	-50
Total, Combustion Systems	-4,939

Turbines

▪ Increase in Vision 21result of turbines for hybrids initiatives	+3,600
▪ Decrease in Next Generation Turbines due to restructuring to focus on hydrogen turbines ...	-3,600
▪ Program Support	-840
Total, Turbines.....	-840

Total, Advanced Systems	-21,701
--------------------------------------	----------------

Total Funding Change, Central Systems	-25,380
--	----------------

Sequestration R&D

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Sequestration R&D					
Greenhouse Gas Control.....	39,101	40,297	49,000	+8,703	+21.6%
Total, Sequestration R&D	39,101	40,297	49,000	+8,703	+21.6%

Description

The mission of the Sequestration R&D program is to create public benefits by discovering and developing ways to economically separate and permanently store (sequester), and to offset, greenhouse gas emissions from the combustion of fossil fuels.

Benefits

The Global Climate Change Initiative (GCCCI) has defined a metric goal of an 18 percent reduction in greenhouse gas intensity over the next ten years. The Sequestration Program will show substantial contributions toward meeting greenhouse gas intensity reduction goals of the GCCCI and provide a portfolio of “commercially ready” technologies to support the decision making process for future action (if required) in 2012, as mandated by GCCCI.

Technology developments will occur such that by the 2012 timeframe, carbon sequestration technologies will be available that result in less than 10 percent increase in cost of energy services for direct capture technologies and less than \$10/ton carbon sequestered for indirect capture technologies. Current capture and sequestration technology options result in at least a 30 percent increase for new plants and a 70 percent increase for retrofit plants. Using results from an FE/NETL analysis, the Sequestration Program has estimated the contribution that various options will make toward meeting the future greenhouse gas emissions reduction needs. Sequestration technologies have the potential to account for more than 30 MMtCE (million metric tons of carbon equivalents) greenhouse gas reduction in 2012 or about a 30 percent direct contribution to the President’s GCCCI goals. Sequestration technologies could potentially account for more than 90 MMtCE of greenhouse gas reduction in 2020 and up to 1025 MMtCE in 2050.

Background

A successful research and development effort will allow the continued use of economical fossil fuels during the transition to a hydrogen economy.

About 90 percent of coal produced in the United States is used for electricity generation and over half of all electricity is produced by coal-fired power plants. Including electricity generated by oil and natural gas-fired power plants, approximately 70% of all electricity produced in the United States is generated

from fossil fuels. The continued use of fossil fuels to generate affordable electricity is critically important to the United States economy and the power generation industry needs to maintain a diversified fuel mix to ensure adequate energy supplies at a reasonable price. The continued use of fossil fuels has many environmental challenges, and sustained use could be severely limited unless satisfactory solutions can be found to overcome these environmental challenges, especially with regard to global climate change and the ability to substantially reduce carbon dioxide (CO₂) emissions in the United States.

Since electric generation is expected to grow and fossil fuels will continue to be the dominant fuel source, there is growing recognition that the public/private collaboration must be part of the solution to curbing greenhouse gas emissions by capturing and permanently sequestering carbon dioxide. The President's recently announced climate change goal is to significantly reduce the greenhouse gas intensity of the United States economy over the next 10 years, while sustaining the economic growth needed to finance investment in new, clean energy technologies. The Carbon Sequestration Program directly supports these and several National Energy Policy (NEP) goals targeting the development of new technologies, market mechanisms, and international collaboration to reduce greenhouse gas intensity and greenhouse gas emissions. The development of carbon capture and sequestration technologies must play a key role if the United States is to set a path to slow the growth of greenhouse gas emissions, and -- if the emerging science justifies -- to stop and then reverse that growth.

The DOE is developing a portfolio of technologies and mitigation strategies designed to reduce the emissions of greenhouse gases using a two-prong approach: (1) Making energy systems more efficient, and; (2) Capture and sequestration of greenhouse gases. The first approach is being addressed by the core fossil energy coal, oil and gas programs and "Vision 21" that seek to almost double the current average efficiency of existing coal power plants by 2015. The second approach is being addressed by the Carbon Sequestration R&D Program. The Carbon Sequestration Program is developing a portfolio of technologies that hold great potential to reduce greenhouse gas emissions. The Program will focus primarily on the following area:

- Developing capture and separation technologies that dramatically lower the costs of reducing carbon dioxide emissions from fossil fuel processes.

The programmatic time line is to develop (to a state of commercial readiness) a portfolio of safe and cost effective greenhouse gas capture, storage and mitigation technologies by 2012, leading to substantial market penetration beyond 2012. Technology developments within the Sequestration Program are expected to significantly contribute to the President's goal of reducing greenhouse gas intensity by 18% by 2012 and would play a critical role should it be necessary to stabilize greenhouse gas emissions in the United States beyond 2012.

In addition to maintaining core R&D, the Sequestration Program will focus on the following programmatic thrusts in FY 2005:

- Pursue sequestration strategies that support zero. This activity enables sequestration opportunities that support the Global Climate Change, Clear Skies and FutureGen Initiatives.

- Strengthen U.S. and DOE leadership in carbon sequestration by pursuing global public/private R&D partnerships through the Carbon Sequestration Leadership Forum. In addition to seeking new opportunities, emphasis will be placed on strengthening and expanding existing cooperative efforts with Canada, Japan, Australia, Italy, Norway, and the European Union.
- Continue the development of the Regional Carbon Sequestration Partnerships. This activity focuses on promoting development of the infrastructure for wide-scale deployment of mitigation technologies and places more emphasis on bringing low-cost, value-added CO₂ capture and storage to the commercial implementation stage before 2012, while establishing the longer-term capability for addressing capture and sequestration from power generation. In FY 2005, the Partnerships will complete the following: (1) identify regional opportunities and benefits; (2) create a baseline and characterize a region by matching source and sink opportunities; (3) address safety, permitting, and public acceptance; and (4) provide technology validation for regional capture and storage opportunities. Planning will be completed and the solicitation for the Phase II Regional Carbon Sequestration Partnerships will also be released in FY 2005.
- Increase R&D focus on restoration of disturbed lands. Strengthen and expand R&D, including collaboration with the Department of Agriculture, Department of Interior and the Environmental Protection Agency to produce near-term benefits that directly contribute to the 2012 greenhouse gas intensity goal of the Global Climate Change Initiative.
- Accelerate Novel Sequestration Systems R&D to create expanded and new means of storing or reusing carbon and other greenhouse gas residuals that provide additional pathways to near zero emissions energy facilities of the future. Strong emphasis will be placed on technologies that offer permanent storage using chemical/biological pathways to inert, benign solids and useful products. The novel concepts projects awarded via collaboration with the National Academy of Sciences (NAS) will be reaching their midpoint in FY 2005 and future NAS collaboration opportunities will be assessed. These efforts will be coordinated with the DOE Office of Science, the IEA/GHG and other science organizations involved in the area.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
■ Greenhouse Gas Control	31,277	33,050	41,580
<p>In FY 2005, continue core R&D program toward meeting the goals in the following areas: developing efficient, low-cost, advanced CO₂ separation and capture concepts; identifying issues associated with carbon sequestration in differing geologic formations, and reducing the cost, and environmental uncertainties (including storage stability, permanence, rates and characteristics of migration) of large-scale carbon sequestration through innovative Public-Private R&D partnerships. Close collaboration with the carbon management science programs and activities in the Office of Science will be maintained for the purposes of applying promising basic science principles to novel concepts, thereby providing an integrated approach to advancing the science and technology of carbon sequestration. Regional partnerships to have (1) identified regional opportunities and</p>			

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

benefits; (2) established a baseline and characterized a region by matching source and sink opportunities; (3) established preliminary monitoring and verification protocols; (4) identified appropriate regulatory framework for sequestration options; and (5) communicated with stakeholders through education and outreach programs. Launch technology validation phase of the regional carbon sequestration partnerships. Complete pilot tests on advanced capture technologies related to membrane and hydrate configurations. Complete field tests for non-CO₂ greenhouse gas mitigation related to fugitive methane emissions from coalmines. Complete field tests for geologic sequestration combined with enhanced coal bed methane recovery. *Participants include: NETL, LANL, Battelle, Praxair, Dakota Gasification, ARI, Nature Conservancy, Univ. of KY, Univ. of TX, VA Tech, MIT, Princeton University, Consol, IEA, TBD.*

In FY 2004, refocus core R&D program toward meeting the goals of the following areas: developing efficient, low-cost, advanced CO₂ separation and capture concepts; identifying issues associated with carbon sequestration in differing geologic formations, and reducing the cost, and environmental uncertainties (including storage stability, permanence, rates and characteristics of migration) of large-scale carbon sequestration through innovative Public-Private R&D partnerships. Close collaboration with the carbon management science programs and activities in the Office of Science will be maintained for the purposes of applying promising basic science principles to novel concepts, thereby providing an integrated approach to advancing the science and technology of carbon sequestration. *Participants include: NETL, LANL, Battelle, Praxair, Dakota Gasification, ARI, Nature Conservancy, Univ. of KY, Univ. of TX, VA Tech, MIT, Princeton University, Consol, IEA, TBD.*

FY 2003 funding continued development of models and predictive tools that will be required to assess the effectiveness of sequestration, advanced CO₂ capture approaches that are significantly less costly (capital and energy penalty costs), practical sequestration technologies specific to the types of geologic reservoirs found in the U.S., advanced fossil fuel conversion systems that produce a concentrated stream of CO₂ ready for sequestration, and measures to capture and control non-CO₂ greenhouse gases, and issue a solicitation for the Integrated Sequestration and Hydrogen Initiative. *Participants included: RTI, Media Processing Technology, LBNL, LLNL, ORNL, Texas Tech University, University of Kansas, TVA, MBARI, Alabama Geological Survey, Ohio University, PSU, University of Utah, OSU.*

■ **Focus Area for Carbon Sequestration Science....** **7,425** **6,844** **6,930**

In FY 2005, the most advanced CO₂ capture sorbent known, LiSiO₄, will be tested in the flexible Modular CO₂ Capture Facility (MCCF) in the fuel gas mode. Several other sorbents will also be evaluated in the MCCF with particular emphasis on support to FutureGen or other large scale demonstrations. Measurement, monitoring & verification activities will continue to develop, evaluate, demonstrate and test new low cost surface and near surface methods for monitoring and verification of the integrity of geologically sequestered CO₂ at domestic sequestration sites, and possibly some foreign sites. NETL will continue to develop the theoretical basis for understanding field results from both the Burlington Resources and the CONSOL CO₂-enhanced coalbed methane

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

recovery projects. New insights and confirmation of previously developed hypotheses that are central to the continued development of coal seam sequestration will be developed. Key laboratory experiments will be conducted that confirm or deny previously developed insights. NETL's geological sequestration core flow laboratory (GSCFL) will obtain drilling core samples from the AEP/Battelle Mountaineer project in New Haven, WV, and begin evaluating the rock's permeability and porosity. The effects of CO₂ injection upon the host rock mineralogy and petrography will be investigated. *Participants include: NETL.*

In FY 2004, refocus activities toward the areas of capture, geologic and deep ocean CO₂ sequestration, establish the scientific and technical bases needed to cost-effectively capture and permanently sequester CO₂. *Participants include: NETL*

FY 2003 funding continued development of wet scrubber systems to concentrate CO₂ from coal-fired power plants, facilities to test and evaluate advanced CO₂ capture systems applicable to both existing and advanced coal conversion processes and determine CO₂ flow characteristics in brine formations and coal seams, a state-of-the-art facility to mimic the formation of CO₂ hydrates in the deep ocean, and models to predict the extent of and verify sequestration of CO₂ in brine formations and in coals seams. *Participants included: NETL*

■ Program Support	399	403	490
Fund technical and program management support.			
Total, Sequestration R&D	39,101	40,297	49,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Sequestration R&D

• Increased funding will be used to accelerate and broaden the characterization of additional regional geologic settings as potential sites for future sequestration, and accelerate the establishment of verification protocols and development of permitting issues to be addressed through the Carbon Sequestration Regional Partnerships	+8,703
Total Funding Change, Sequestration R&D	+8,703

Fuels

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Fuels					
Transportation Fuels and Chemicals.....	21,432	21,927	16,000	-5,917	-27.0%
Solid Fuels and Feedstocks.....	5,808	5,986	0	-5,986	-100.0%
Advanced Fuels Research.....	3,193	3,308	0	-3,308	-100.0%
.....					
Total, Fuels	30,433	31,221	16,000	-15,221	-48.8%

Description

The mission of the Fuels program is to create public benefits by conducting the research necessary to promote the transition to a hydrogen economy. Research will target reducing costs and increasing efficiency of derived hydrogen from coal feedstocks as part of the President's Hydrogen Fuel Initiative.

Benefits

Coal has the potential to be an affordable resource that can produce the large amounts of hydrogen needed in the mid-term for the Nation to begin the transition to a hydrogen economy. Hydrogen produced from Coal and used in advanced technologies, especially in efficient fuel cell vehicles (FCVs), will improve energy security by reducing the United States' oil imports by over 3 million barrels per day for every 100 million FCVs or nearly half of the U.S. fleet. Even without sequestration, production and use of coal-derived hydrogen in 100 million FCVs is estimated to also reduce carbon dioxide, a greenhouse gas (GHG), by 278 million tons per year, a reduction of 24 percent of the carbon dioxide emissions associated with the current U.S. light-duty vehicle fleet. Nitrogen oxide (NO_x) emissions will be reduced by about 100,000 tons per year, while sulfur oxides (SO_x) and particulate matter emissions would be reduced by 43 thousand tons and 40 thousand tons, respectively. When hydrogen production from fossil fuels is combined with carbon sequestration, carbon dioxide emissions will be reduced by over 530 million tons per year for each 100 million FCVs, a reduction of 45 percent for the current U.S. light-duty vehicle fleet. Also, a 250-year supply of coal to produce hydrogen ensures that there will be a clean and affordable alternative to imported oil.

Background

Currently, the United States imports approximately 11 million barrels per day of petroleum crude and finished products (55% of consumption). By 2025 imports are projected to rise to 19.8 million barrels per day of crude and refined products (68% of consumption). Coal-derived hydrogen can be an important part of a strategy to diversify and expand our domestic fuel resource base, reduce emissions from the transportation sector, and help limit our reliance on imported oil.

In addition to energy security issues, major challenges facing transportation are urban and regional air pollution and emissions of greenhouse gases. EIA 2000 data indicates that of man-made emissions, the U.S. transportation sector is responsible for nearly 80 percent of the carbon monoxide (CO), over one half of the nitrogen oxides (NO_x), and 40 percent of the volatile organic compounds (VOC). Vehicles are responsible for about 35% of the U.S. energy sector's carbon dioxide production. As the Nation transitions toward advanced engine platforms, ultra-low emission vehicles and eventually to near-zero emission vehicles, such as the Administration's fuel cell-powered "FreedomCAR", the demand for hydrogen will increase dramatically. The Administration's Hydrogen Fuel Initiative is a coordinated effort among the Department's Offices (EERE, FE, NE, Science) to provide the technology for the private sector to meet the anticipated hydrogen demand and the infrastructure needed to provide the hydrogen to the end-user. Our large domestic resources of coal can provide high volume, low-cost, hydrogen for fuel cells in the longer term.

Research will address the development of technologies to produce, distribute and store hydrogen as an affordable, safe fuel for consumers. Specifically, this research activity will encompass a technology envelope that begins with the separation of hydrogen from mixed gas streams and conclude with the interface of the hydrogen with fuel cells and other end-use systems. In FY 2004, research will target the development of technologies (1) capable of economically producing large quantities of pure hydrogen from coal-derived synthesis gas, (2) capable of safely and economically storing, distributing and handling hydrogen derived from coal gasification processes for end-use in the utility, transportation, commercial, industrial and residential markets, and (3) that will enable hydrogen from coal feedstocks to play a major role in the transition to sustainable hydrogen based energy systems.

Centralized production of hydrogen from coal feedstocks will produce a concentrated stream of carbon dioxide which will facilitate its economic capture and sequestration. There are two routes to supplying hydrogen from these advanced coal gasification facilities. A portion of the hydrogen can be separated from the mixed gas stream (i.e. synthesis gas) which is produced during the gasification process and then stored for distribution. The other alternative is to produce, via synthesis gas conversion processes, zero-sulfur, high hydrogen content coal-derived fuels that can be moved through the present distribution system, then reformed at facilities in close proximity to the customer or directly on-board the vehicle.

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Transportation Fuels and Chemicals	21,432	21,927	16,000
---	---------------	---------------	---------------

This program conducts laboratory and process research to develop advanced technology for producing ultra clean fuels and hydrogen from coal by use of gasification technology possibly with coproduction of electricity and other products.

• Reactor/Process Development	2,400	1,491	0
--	--------------	--------------	----------

No funding is requested for this activity in FY 2005.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

FY 2003 and FY 2004 funding will be used to continue the coproduction feasibility studies to establish optimal marketable products and plant configurations for specific facilities for production of clean synthesis gas derived liquid fuels, clean electric power and heat based on coal gasification.

- **Syngas Membrane Technology** **6,310** **6,552** **0**

In FY 2005 no funds are requested for this activity.

FY 2003 and FY 2004 funding continued exploratory research activities of novel conversion concepts of promising chemical and small-scale physical conversion technology innovations. Continued research and development of a novel syngas ceramic membrane technology to enhance Fischer-Tropsch (F-T) gas conversion for environmentally superior liquid fuels and hydrogen. Conducted fundamental supporting fuels research at NETL. *Participants included: APCI, NETL, LANL, Univ. Of Alaska, Canmet, Praxair.*

- **Ultra Clean Fuels** **10,222** **8,786** **0**

In FY 2005 no funds are requested.

FY 2003 and FY 2004 funding continued cost-shared industrial research for the development of ultra-clean fuels technology for fossil resources (natural gas, petroleum, coal). Projects will continue to develop advanced technology for the production of natural gas derived synthesis gas and ultra-clean fuels. Funding will also be provided for the completion of a novel, molten metal reactor for production of hydrogen with a concentrated stream of carbon dioxide for capture from coal-based feedstock.

- **Hydrogen from Coal Research** **2,280** **4,879** **15,840**

In FY 2005, perform research for the development of novel technology for: 1) separating hydrogen from mixed gas streams (continuation) including polishing technology to remove remaining impurities prior to utilization (new); 2) producing high hydrogen content coal-derived liquids for subsequent reforming on-board vehicles and/or at distributed generation facilities (continuation); 3) storing and delivering hydrogen/liquid hydrogen carriers (continuation); 4) utilizing hydrogen in non-fuel cell powered applications (new); 5) small-scale hydrogen production systems with CO₂ capture/sequestration capability (new), and utilize NETL's computation science expertise to provide 6) the technical foundation upon which to facilitate the development of advanced system components associated with the production, delivery, storage and utilization of hydrogen from coal (continuation and expansion)

In FY 2004, initiate hydrogen from coal initiative by competitive procurement. Identify appropriate organizations to (1) establish the feasibility of emerging alternate coal-based hydrogen technologies, (2) investigate advanced separation technologies, and (3) utilize a combination of experimental and advanced computational methods to determine optimal reaction chemistries for producing hydrogen from coal-derived fuels. *Participants include: NETL, TBD.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

FY 2003, continue funding to test advanced hydrogen separation membranes and evaluate carbon fibers for high density hydrogen storage; and initiate five new projects to separate hydrogen from mixed gas streams and produce hydrogen from coal-derived methanol via an advanced reforming process. *Participants include: NETL TBD.*

- **Program Support**..... **220** **219** **160**

Fund technical and program management support.

- Solid Fuels and Feedstocks**..... **5,808** **5,986** **0**

Research provided advanced technologies to produce clean high value carbon products from coal such as high purity carbon electrodes and specialty graphite. Composite fuels comprised of coal and waste biomass for greenhouse gas reduction and separation technology for producing additional clean coal from wastes.

- **Premium Carbon Products**..... **1,027** **987** **0**

No funding requested in FY 2005.

FY 2003 and FY 2004 funding is to continue development of novel processes to produce high value graphics, activated carbon, carbon fibers for high strength materials, carbon foams for military applications and carbon electrodes for batteries and fuel cells. *Participants include: Penn State, NETL.*

- **Advanced Separation** **2,881** **2,964** **0**

No funding requested in FY 2005.

FY 2003 and FY 2004 funding is to continue developing processes for reclamation of coal fines to monetize coal from waste coal sites and mitigate potential environmental issues associated with these sites; and to develop solid-liquid coal separation processes that have crosscutting applicability the mineral industry. *Participants include: Virginia Tech, WVU.*

- **Coal-derived Jet Fuels**..... **1,840** **1,975** **0**

No funding requested in FY 2005.

FY 2003 and FY 2004 funding is to initiate research and development to determine the technical requirements and cost implications of integrating the coal-derived jet fuel production and by-product processes into refinery operations.

- **Program Support**..... **60** **60** **0**

Fund technical and program management support.

- Advanced Fuels Research**..... **3,193** **3,308** **0**

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Provide the scientific underpinning for the development of advanced ultra clean liquid fuels and hydrogen technology from coal.

- **Advanced Research** **3,160** **3,275** **0**

No funding is requested for this activity in FY 2005.

FY 2003 and FY 2004 funding is to provide supporting science that will facilitate the development of high-efficiency, affordable processes for converting coal to high value fuels, including hydrogen and hydrogen precursors; and to develop a coal extraction process that provides precursor chemicals suitable for production of premium coal-derived materials.

- **Program Support**..... **33** **33** **0**

Fund technical and program management support.

Total, Fuels	30,433	31,221	16,000
---------------------------	---------------	---------------	---------------

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Transportation Fuels and Chemicals

- Complete synthesis gas membrane activities to develop novel ceramic membrane reactors for producing synthesis gas and hydrogen production -6,552
- Complete reactor/process development and ultra-clean fuels activities for production of clean low sulfur liquid fuels -10,277
- Continue Hydrogen from Coal Research to developed improved, novel technology for the production of hydrogen and its separation, delivery, storage and utilization at lower cost including the initiation of studies for advanced concepts for simultaneous separation of carbon dioxide, H₂S and other trace components from hydrogen +10,961
- Program Support..... -59

Total, Transportation Fuels and Chemicals	-5,927
--	---------------

FY 2005 vs. FY 2004 (\$000)

Solid Fuels and Feedstocks

• Complete premium carbon, advanced mining separation and jet fuel activities.....	-5,926
• Program Support.....	-60
Total, Solid Fuels and Feedstocks	-5,986

Advanced Fuels Research

• Complete advanced research activities for C1 conversion for producing clean liquid fuels and reformable fuels and coal extraction to produce high value products	-3,275
• Program Support.....	-33
Total, Advanced Fuels Research	-3,308

Total Funding Change, Fuels.....	-15,221
---	----------------

Advanced Research

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Advanced Research					
Coal Utilization Science	8,781	11,852	8,000	-3,852	-32.5%
Materials	8,712	11,111	8,000	-3,111	-28.0%
Technology Crosscut	11,078	11,326	10,500	-826	-7.3%
University Coal Research	2,904	2,945	3,000	+55	+1.9%
HBCUs, Education & Training	969	981	1,000	+19	+1.9%
Total, Advanced Research.....	32,444	38,215	30,500	-7,715	-20.2%

Description

The mission of the Advanced Research subprogram is to serve as a bridge between basic and applied research to foster the development and deployment of innovative systems for improving efficiency and environmental performance, while reducing costs, of Advanced Coal and Power Systems.

Benefits

Advanced Research provides the means by which advanced concepts are transformed into future working technologies. It is crosscutting in nature and supports all Fossil Energy Coal and Power Systems in its development of highly efficient power plants with zero emissions and also FutureGen. Improvement of our energy infrastructure, which includes power plants, power transmission systems, environmental protection and remediation efforts, is dependent on research. This research must produce technologies that meet the performance specifications for hostile operating conditions, economic constraints of advanced industrial applications, and public demand for a cleaner environment, reliability, and low consumer cost. These constraints require that advanced Research develop fundamental understandings of relationships among energy processes, their performance requirements, and the environment through a greater understanding of the physical, chemical, biological and thermodynamic barriers to achieving these goals. Especially important research is being conducted in the areas of materials research, sensors and controls, and computational energy science that is expected to eliminate the need for constructing expensive pilot plants.

Background

The Advanced Research Program works to create public benefits through two types of activities. The first is a set of crosscutting studies and assessment activities in environmental, technical and economic analyses, coal technology export and international program support. The public benefits from these activities because the improvement of programs and regulatory activities will help to maximize their benefits and lower their costs. The second is a set of crosscutting fundamental and applied research

programs which include coal utilization science, materials, bioprocessing of coal, and university-based research. The public benefits from these activities because the long-term, high-risk activities target areas where industry is reluctant to invest. These research activities can produce public benefits such as increased energy efficiency, reduced pollution, or more reliable power supplies. For example, the university-based research programs include the University Coal Research program and the Historically Black Colleges and Universities and Other Minority Institutions (HBCU/OMI) program, address the full spectrum of fossil utilization research and development, technology transfer, outreach, and private sector partnerships.

In the crosscutting studies and assessments subprograms, the thrusts of international program support, environmental activities, coal technology export, and technical and economic analysis are to complement and enhance all Fossil Energy endeavors by providing both financial and technological leverage. International involvement is limited to those selected areas where it has been determined that the U.S. will benefit at least to the extent it contributes. Fossil Energy, through these activities, always attempts to encourage the leveraging of research and development funds while promoting U.S. industrial interests and to use them as opportunities to achieve responsible international consensus and opinion on technical business assessment and policy issues.

The crosscutting fundamental and applied research programs focus upon developing the technology base in the enabling science and technology areas that are critical to the successful development of both superclean, very high efficiency coal-based power systems and coal-based fuel systems with greatly reduced or no net emissions of CO₂. These systems are encompassed in the Vision 21 energyplex and FutureGen initiative. Advanced Research seeks a greater understanding of the physical, chemical, biological and thermodynamic barriers to achieving economic, technologic, and environmental goals and identifies ways to overcome those barriers. The program is unique in that it is directed to specific underlying fundamental scientific and engineering problems closely connected to short-term, mid-term and long-range Fossil Energy objectives.

In order to achieve these goals, an Advanced Research focus area on Computational Energy Sciences was established at the National Energy Technology Laboratory (NETL). This focus area will conduct simulations and modeling activities to produce a "technology base" from which the energy plants of the future will be designed, built and operated.

The Coal Utilization Science subprogram focuses on research pertinent to all coal utilization systems, with specific attention paid to increasing our knowledge of the principal mechanisms that control coal conversion processes. It will address issues affecting the utilization of coal, and its primary thrust is in support of the development of the Vision 21 concept. It will involve novel concepts for CO₂ capture and sequestration, such as mineral carbonation, and virtual simulations and modeling of components and subsystems. It will also include research on instrumentation and diagnostics to support the development of advanced controls and sensors. High performance Advanced Materials and equipment are essential to advanced coal technologies. Thus, the thrust of the Advanced Materials subprogram is to develop materials for advanced gas separation and particulate removal, as well as to develop solutions to materials performance barriers unique to very high temperature, highly corrosive coal combustion and gasification environments. Exploratory research and innovation to maximize the use of coal in environmentally preferable ways is typified by the bioprocessing of coal subprogram. The focus of the

Biotechnology subprogram is to conduct biological research to produce clean fuels and to reduce greenhouse gas emissions (NO_x, SO_x, and CO₂) from existing and new powerplants. The University Coal Research and HBCU/OMI subprograms are both education and training programs that support competitively awarded research grants at U.S. colleges and universities to address Fossil Energy's highest priority research needs.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Coal Utilization Science	8,781	11,852	8,000
• Coal Utilization Science (Core)	8,692	6,802	7,920

In FY 2005, conduct research that supports the development of highly efficient and clean power plants, focusing on the reduction or elimination of adverse environmental impacts of coal use. Sensors and controls: Complete prototype development and testing of sensors critical to enhancing and controlling plant efficiencies and emissions. Continue to develop new class of sensors based on projects selected through FY 2002 and FY 2003 solicitations that are suitable for monitoring in harsh conditions that will enable the operation of ultra-clean fossil energy systems. Enabling Technologies: Complete development of computational workbench for Vision 21. Initiate mechanistic 3D modeling of Vision 21 plant. Continue to investigate basic combustion and gasification chemistry to discern rates and mechanisms that control emissions behavior of coal under advanced and conventional combustion/gasification conditions to efficiently minimize NO_x, SO_x, air toxics, and other pollutants in support of the clear skies initiative. Complete integration of mechanical, chemical, and chemico-mechanical pretreatment into CO₂ mineral carbonation process. No funds for Arctic Energy Office. *Participants include: NETL, SNL, CMU, U. of Pittsburgh, ARC, Ohio State U., REI, U. of FL, MSU.*

In FY 2004, conducted research to enable reduction or elimination of environmental impacts of coal use; focus on greenhouse gases that may affect global climate change. Sensors and Controls: Completed pilot-scale tests of select gasification and combustion sensors; complete feasibility tests of other sensor development projects selected under FY 2002 solicitations. Select fewer projects for award under FY 2003 solicitations for fundamental sensor devices including applications of nanotechnology. Continued stochastic modeling and systems analysis for zero emissions power plants concepts and FutureGen. Completed Round 2 course grid simulations and computational workbench projects and continued projects selected under round III of broad-based agency Vision 21 solicitation to develop critical enabling technologies for advanced zero emissions power and fuel systems. Investigated basic combustion and gasification chemistry to discern rates and mechanisms that control emissions behavior of coal under advanced and conventional combustion gasification conditions to efficiently minimize NO_x, SO_x, air toxics, and other pollutants in support of the Clear Skies Initiative. Developed predictive models as a tool for designers of Vision 21 plants. Demonstrate the feasibility of the in-situ CO₂ mineral sequestration

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

concept through laboratory tests of drill-core samples and maintain minimum levels of fundamental lab-scale research to addresses process design issues. Continue support for the Arctic Energy Office Activities. *Participants include: NETL, SNL, CMU, U. of Pittsburgh, Princeton, ARC, University of Alaska.*

FY 2003 funding continued development of instrumentation, diagnostics and controls for advanced power systems; model testing and research for Virtual Demonstration plant; development of critical enabling technologies in support of Vision 21; fundamental coal combustion research; and research on fundamental mechanisms for CO₂ mineral sequestration process, and continue support for the Arctic Energy Office activities. *Participants included: Ames Research Lab, SNL, ARC, LANL, NETL, SAIC.*

- **Mercury Control.....** 0 1,961 0

No funding requested in FY 2005.

In FY 2004, conducted fundamental research on mercury formation and control. As part of a new sensors and control solicitation, developed sensors to detect and monitor mercury emissions. Developed atmospheric modeling (plume chemistry and deposition) with a focus towards mercury. *Participants to be determined.*

No funding was requested for this activity in FY 2003.

- **Center for Zero Emissions Coal Research** 0 2,970 0

No funding requested in FY 2005.

In FY 2004, create a strategic center for zero emission coal research at the High-Temperature Electrochemistry Center (HiTEC) to conduct research in support of advanced coal programs and FutureGen, and to enhance collaboration between Universities and national Labs. *Participants include: Montana State Univ., NETL.*

No activity in FY 2003.

- **Program Support.....** 89 119 80

Fund technical and program management support.

Materials 8,712 11,111 8,000

- **High Temperature Materials Research.....** 5,365 5,682 3,976

In FY 2005, develop a new generation of corrosion resistant high temperature alloys and refractories that will be used as hot components in advanced fossil energy combustion and conversion systems. Laboratory research is accompanied by testing of the alloys in actual power

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

plant conditions. Demonstrated stability of proton-conducting ceramics in atmosphere of coal-derived gas and operated membrane reactor to produce low cost hydrogen from coal. *Participants include: ANL, INEEL, ORNL, ARC, Ames, Eltron, NETL.*

In FY 2004, continued to develop improved materials for high-temperature, high-pressure heat exchangers, high-temperature inorganic membranes, refractories, and activated carbons for next generation, ultra clean fossil energy power systems. Continued to develop new alloys to include intermetallics, advanced austenitic alloys, advanced ferritic alloys, and oxide-dispersion-strengthened alloys. Functional materials research addressed hot-gas particulate filters, gas separation membranes, and physical absorbents, i.e, advanced carbons and non-destructive evaluation techniques. *Participants included: ANL, INEEL, ORNL, Ames, Eltron, Special Materials, NETL, U. of Cal at SD.*

FY 2003, funding continued development of the high temperature structural and functional materials that are critical enabling technologies needed to achieve the highly efficient, economical and environmentally clean fossil energy power systems for Vision 21. *Participants included: ANL, INEEL, ORNL, Eltron, Ames, ARC, Special Materials, NETL, U. of Cal at SD.*

- **Materials for Ultra Supercritical and Gas Separation Systems**

3,260 4,503 3,944

In FY 2005, identify improved alloys, fabrication processes and coating methods that will permit boiler operation of steam temperatures up to 1400° F and steam pressures up to 5500 psi. Work with alloy developers, fabricators, equipment vendors and power generation plant operators to obtain cost targets for the commercial deployment of alloys and processes developed. Define issues impacting designs that can permit power generation at steam temperatures greater than or equal to 1600° F. Identify materials needed to develop steam turbines capable of operating at the ultra supercritical temperature and pressure conditions and develop a plan to evaluate and qualify materials for the critical components. Increase permeance of new membrane materials for achieving very low cost hydrogen and oxygen separation from mixed gas streams achieving repeatability with defect-free membranes, and employing techniques that can be used in manufacturing on a large scale. Study impact of new materials and processes for stabilizing greenhouse gases for next generation energy plants. *Participants include: LANL, SNL, ORNL, PNNL, Energy Industries of Ohio.*

In FY 2004, developed alloys for ultra supercritical systems with operating temperatures raised to 1400-1600°F; ensure the weldability of these high temperature materials, and developed the base materials technology needed to develop steam turbines capable of operating at the ultra supercritical temperature and pressure conditions which are critical to the success of not only the ultra supercritical program, but also the Vision 21 program. Pursued breakthrough concepts to develop materials for achieving very low cost hydrogen and oxygen separation from mixed gas

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

streams and for stabilizing greenhouse gases for Vision 21 energy plants. *Participants include: LANL, SNL, ORNL, PNNL, ARC, Energy Industries of Ohio.*

FY 2003 funding supported development of alloys for ultra supercritical systems and new materials able to separate hydrogen and oxygen and for stabilizing greenhouse gases at very low costs. These are critical enabling technologies needed to make deployment of Vision 21 energy plants possible. *Participants included: LANL, SNL, ORNL, PNNL, ARC, Energy Industries of Ohio.*

- **Materials for Mercury Control**..... 0 500 0

In FY 2005, no funding is requested for this activity.

In FY 2004, evaluated novel materials for the conversion or removal of mercury from process streams. *Participants to be determined.*

No funding was requested for this activity in FY 2003.

- **Materials for Advanced Fuel Cell Concepts** 0 315 0

In FY 2005, no funding is requested for this activity.

In FY 2004, developed advanced concepts that utilize carbon material from coal directly in a fuel cell. Such a concept will permit high and intermediate temperature fuel cells to directly convert carbon to electrical power without the need of an intermediate coal gasification step. National Laboratories may also contribute materials research in support of other advanced fuel cell concepts. *Participants to be determined.*

No funding was requested for this activity in FY 2003.

- **Program Support**..... 87 111 80

Fund technical and program management support.

Technology Crosscut..... 11,078 11,326 10,500

Coal Technology Export..... 795 988 1,000

- **Coal Technology Export** 795 988 1,000

In FY 2005, intensify the facilitation of the development and deployment of Zero Emissions Technologies for fossil fuels internationally. Continue compounding the pursuit of opportunities identified by the World Energy Council Committee on Cleaner Fossil Fuel Systems and the Southern States Energy Board for the international sale and deployment of U.S. clean coal technologies and advanced power systems. Strengthen established partnerships and pursue the

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

establishment of additional effective partnerships to advance U.S. interest in environmental protection by promoting deployment of cleaner energy systems through training, conferences, site visits and information and technical exchanges on clean power systems, best practices, privatization with targeted utilities and governments, and advising countries on identification and elimination of barriers for deployment of cleaner coal and power systems. Promote the deployment of carbon capture and storage technologies worldwide, and provide support for the Carbon Sequestration Leadership Forum. Initiate the implementation of Clean Energy/Industrial Ecology Projects in developing countries as a means of Mitigating CO₂ emissions growth as these countries expand electrification. *Participants to be determined.*

In FY 2004, sustained continued support for collaboration of zero emission technologies internationally. Intensified the pursuit of opportunities identified by the World Energy Council Committee on Cleaner Fossil Fuel Systems and the Southern States Energy Board for the international sale and deployment of U.S. clean coal technologies and advanced power systems. Continue pursuit of the establishment of effective partnerships to advance U.S. interests in environmental protection by promoting deployment of cleaner energy systems through training, conferences, site visits and information and technical exchanges on clean power systems, best practices, privatization with targeted utilities and governments and advising countries on identification and elimination of barriers for deployment of cleaner coal and power systems. This funding level supported fewer conferences and site visits when compared to FY 2003. *Participants to be determined.*

FY 2003 funding continued development of training, conferences, site visits, and information and technical exchanges in order to promote the deployment of cleaner energy. *Participants included: Latin America, China, Australia, Africa, India.*

Bioprocessing of Coal	1,341	1,481	1,500
• Bioprocessing of Coal	1,328	1,466	1,485

In FY 2005, continue testing at large scale (power plant) toxin process to safely control zebra mussels as a means of improving the efficiency and reliability of existing power plants. Continue development of technical protocol for screening marine microalgae for maximum biofixation and its conversion into alternative fuels. Complete development of bench scale testing of biohydrogen from carbon containing waste products to determine food sources that will support microbial growth and hydrogen production. Continue to investigate global, and natural CO₂ sequestration. Demonstrate whittings catalyzed CO₂ fixation at pilot scale. Investigate production value of added chemicals via nonaqueous biocatalysis. Continue bioremediation of coal to reduce mercury emissions when burned in power plants. *Participants include: ORNL, INEEL, PNNL, NY State U., NETL.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

In FY 2004, initiated large scale testing to develop toxin to safety control zebra mussels as a means of improving the efficiency and reliability of existing power plants. Initiated development of technical protocol for screening marine microalgae for maximum biofixation and its conversion into alternative fuels. Investigated global, natural CO₂ mitigation strategies such as whittings and ocean scale algae sequestration. Continued development of biogeochemical environmental remediation of ammonia discharges associated with coal wastes from existing power plants. In furtherance of launching the hydrogen economy, investigated biohydrogen generation from carbon containing waste products to determine food sources that will support microbial growth and hydrogen production, conduct tests at bench scale. Investigated novel bio-environmental remediation processes related to coal conversion technology. *Participants include: ORNL, INEEL, U. State of NY, Cal. State U.*

FY 2003 funding continued development of CO₂ mitigation strategies, such as whittings; develop toxin for control of zebra mussels; and biohydrogen generation from carbon containing waste products. *Participants included: ORNL, INEEL, U. of State of NY, Calif. State U.*

• Program Support	13	15	15
--------------------------------	-----------	-----------	-----------

Fund technical and program management support.

Environmental Activities	1,987	1,975	2,000
---------------------------------------	--------------	--------------	--------------

• Environmental Analyses and Studies	1,987	1,975	2,000
---	--------------	--------------	--------------

In FY 2005, continue analyses of issues associated with air and water quality, solid waste disposal, and toxic substances, and global climate change. Continued emission trends and forecast studies. *Participants include: ANL, ICF, Resource Dynamics, TMS, PNNL*

In FY 2004, continued analyses of issues associated with air and water quality, solid waste disposal, and toxic substances, and global climate change. Continued emission trends and forecast studies. *Participants include: ANL, ICF, Resource Dynamics, TMS, PNNL.*

FY 2003 funding continued environmental issues analyses of ambient, water, solid effluents, and global climate change and conducted emission trends and forecast studies. *Participants included: ANL, ICF, Resource Dynamics, TMS, PNNL.*

Technical and Economic Analyses	994	988	1,000
--	------------	------------	--------------

• Technical and Economic Analyses	994	988	1,000
--	------------	------------	--------------

In FY 2005, continue studies supporting multi-year planning FE strategy and program formulation; conducted contract fewer studies on issues that crosscut FE programs including strategic benefits of and new markets for fossil fuel technology. Conducted critical studies to

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. *Participants include: ANL, ICF, EIA, Resource Dynamics, TMS.*

FY 2004 funding continued studies supporting multi-year planning FE strategy and program formulation; conducted contract fewer studies on issues that crosscut FE programs including strategic benefits of and new markets for fossil fuel technology. Conducted critical studies to identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. *Participants include: ANL, ICF, EIA, Resource Dynamics, TMS.*

FY 2003 funding continued studies supporting multi-year planning, FE strategy and program formulation; conducted contract studies on issues that crosscut FE programs including strategic benefits of and new markets for fossil fuel technology. Conducted critical studies to identify major challenges, "leapfrog" technologies, and advanced concepts that are applicable to fossil energy systems, and have the potential to improve their efficiency, cost, and/or environmental performance. *Participants included: ANL, ICF, EIA, Resource Dynamics, TMS.*

International Program Support	994	988	1,000
• International Program Support.....	994	988	1,000

In FY 2005, continue Fossil Energy's commitment to the International Energy Agency (IEA) program support. Continue to provide leadership, direction, cooperation and coordination of office activities with other Federal agencies, state and local governments, energy trade associations, and the energy industry. Continue preservation and enhancement of active relationships with national and international organizations such as the World Energy Council (WEC), United States Energy Association (USEA), Southern States Energy Board (SSEB), and universities and other non-governmental organizations. Enhance the expansion of cleaner energy technology power systems activities in southern and western regional African countries, eastern Europe, the Pacific Rim, Russia and Newly Independent States, South Asia/Near East, western Europe, and the Western Hemisphere. Promote the deployment of carbon capture and storage technologies worldwide. Influence opportunities for cleaner power systems and clean fuels from coal in selected countries. Initiate the implementation of Clean Energy/Industrial Ecology Projects in developing countries as a means of mitigating CO₂ emissions growth as these countries expand electrification. *Participants to be determined.*

FY 2004 funding continued support of Fossil Energy's commitment to the International Energy Agency (IEA) program effort. Provide leadership, direction, cooperation and coordination of office activities with other Federal agencies, state and local governments, energy trade associations, and the energy industry. Preserved and enhanced active relationships with national and international organizations such as the World Energy Council (WEC), United States Energy

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Association (USEA), Southern States Energy Board (SSEB) and universities and other non-governmental organizations. Focused on expanding cleaner energy technology power systems activities in Southern and Western regional African countries, Eastern Europe, the Pacific Rim, Russia and Newly Independent States, South Asia/Near East, Western Europe, and the Western Hemisphere. Determined opportunities for cleaner power systems and clean fuels from coal in targeted countries. *Participants to be determined.*

FY 2003 funding continued the maintenance and heightening of established relationships with national and international organizations with emphasis on collaboration, transfer, and deployment of zero emission technologies. *Participants included: WEC, USEA, SSEB, universities and other non-governmental organizations.*

Focus Area for Computational Energy Science	4,967	4,905	4,000
• Focus Area for Computational Energy Science.....	4,917	4,856	3,960

In FY 2005, NETL to continue development of virtual simulations capability using mathematical computational simulations and modeling to accelerate development time and reduce costs of technology systems that have high efficiencies with near-zero emissions to reduce the effects of coal use on global warming. Begin to apply the virtual integrated simulators of high efficiency and near-zero emission processes to study proposed systems and evaluate their design and performance. Analyze and evaluate these advanced processes, using the advanced simulation capability, at both the individual component level and overall system level. Complete the initial application of process simulation of high efficiency and near-zero emission process incorporating MFIX-based component model describing an advanced gasification process to provide detailed information describing the gasification process. Complete the initial application of process simulation of high efficiency and near-zero emission process based on fuel cell/gas turbine hybrid system which incorporates a detailed fuel cell component model that will provide detailed information describing fuel cell stack performance. At a reduced level of effort, continue the Supercomputing Science Consortium support activities in advanced simulations by providing high performance computing, internet access, technical support and visualization development in direct support of virtual integrated simulators. Complete a virtual integrated simulation of a high efficiency and near-zero emission process, such as a hybrid or advanced gasifier, to demonstrate the ability to simulate a dynamic coupled system. *Participants include: NETL, CMU, U. of WVU, State of WV, PSCC, U. of Pittsburgh.*

In FY 2004, NETL continued development of virtual demonstration capability using mathematical simulations and modeling to improve the speed and reduce the costs of technology systems that have high efficiencies with near-zero emissions to reduce the effects on global warming. Developed simulations that couple fluid flow, chemical reactions, heat generation, heat transfer, and electrochemistry for modeling multi-dimensional transients in fuel cells, heat engines, gasifiers, and other crucial unit processes in Vision 21 plants. Completed CFD models of fuel

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

cells, turbines, and gasifiers. Enhanced multi-phase flow models (MFIx) with meshing, large eddy simulations and chemistry and heat transfer improvements. Integrated subsystem component modules and dynamic system models to simulate a first case Vision 21 plant. Continued to perform data reduction and data extraction on extensive information available from simulations of advanced energy plants for incorporation into codes being developed. Continue supercomputing Science Consortium supporting activity in advanced simulations by providing high speed computing, technical support, and visualization simulations. *Participants include: Carnegie Mellon University, University of West Virginia, Pittsburgh Supercomputing Center, University of Pittsburgh.*

FY 2003, funding continued development of models and dynamic simulations of advanced energy plants, including modeling tools for sub-elements in turbines and fuel cells. Integration of subsystem component modules and dynamic system models into virtual models. Supercomputing Science Consortium support in advanced simulations utilizing high performance computing and communications. *Participants included: NETL, CMU, U. of WV, State of WV, PSCC, U. of Pittsburgh.*

• Program Support	50	49	40
--------------------------------	----	----	----

Fund technical and program management support.

University Coal Research	2,904	2,945	3,000
---------------------------------------	--------------	--------------	--------------

• University Coal Research	2,875	2,916	2,970
---	--------------	--------------	--------------

In FY 2005, the University Coal Research (UCR) Program plans to continue to support grants at U.S. colleges and universities by emphasizing longer-term research for achieving Fossil Energy's strategic objectives. Critical key research areas that accelerate technology development and seeking to identify breakthrough technologies for the next century will be supported. The key research areas that will be supported will include: Vision 21, hydrogen initiative, global climate change, coal-based mercury emissions, materials, sensors and controls, and coal-by-product utilization for the measurement, characterization, and the development of cost-effective control technologies.

Support will continue in all three portions of the UCR Program: the Core, Innovative Concepts Phase-I and, Innovative Concepts Phase-II areas. Under the Core area, the program will continue to encourage collaboration through joint proposals involving university/industry teams. \$200,000 to \$400,000 grants will be awarded in this area. The number of grants will depend on the number of meritorious proposals submitted.

Exploration of novel approaches and innovative concepts developed in other scientific and technological areas that assist in developing breakthrough technologies for coal utilization will

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

also be continued in the Innovative Concepts Phase-I and Phase-II areas. Approximately six to eight, \$50,000, one year, Innovative Concepts Phase I grants could be awarded. Further, plans are to continue the Innovative Concepts Phase II Program where one or more Phase I projects can be selected for a \$200,000 Phase-II grant award. *Participants to be determined.*

FY 2004, funding supported grants at U.S. universities which emphasized longer-term research that will accelerate technology development and identify breakthrough technologies for the next century; focus was on scientific and technological issues that are key to achieving FE's strategic objectives. The support continued in critical key research areas to include Vision 21, global climate change, materials, sensors and controls, and by-products from coal. Breakthrough technologies for the measurement, characterization, and the development of cost-effective control technologies for fossil coal-based mercury emissions was also sought. *Participants to be determined.*

Exploration of novel approaches and innovative concepts developed in other scientific and technological areas that assist in developing breakthrough technologies for coal utilization was continued. Approximately six to eight, \$50,000, one year, Innovative Concepts Phase-I Projects could be awarded. Further, plans are to continue the Innovative Concepts Phase II program.

FY 2003, funding provided competitively awarded research grants to U.S. colleges and universities to address FE's highest priority research needs, supported joint proposals involving university and industry teams of researchers, and continued to explore novel approaches and Innovative solutions to achieve technological breakthroughs for clean coal utilization and support to Vision 21. *Participants included: Various colleges and universities.*

• Program Support	29	29	30
--------------------------------	-----------	-----------	-----------

Fund technical and program management support.

HBCUs, Education and Training	969	981	1,000
--	------------	------------	--------------

• HBCUs, Education and Training	959	971	990
--	------------	------------	------------

Conduct research activities with HBCU and other minority institutions and support an HBCU annual technology transfer symposium. *Participants to be determined.*

FY 2004 and FY 2003 funding continued research activities at HBCU and other minority institutions and supported HBCU annual technology transfer symposium. *Participants included: Various colleges and universities.*

• Program Support	10	10	10
--------------------------------	-----------	-----------	-----------

Fund technical and program management support.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Total, Advanced Research	32,444	38,215	30,500

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Coal Utilization

- Eliminate funding for mercury control. No funding is requested for the Center for Zero Missions Coal Research which was established in FY 2004. Since there will be a delay in fully implementing this program in FY 2004, current funding will continue the program through FY 2005. Increased funding for sensors and control and enabling technologies activities..... -3,852

Materials

- Decrease funding for high temperature materials research and materials for ultra supercritical and gas separation activities. Eliminate funding for mercury control and materials for advanced fuel cell concepts..... -3,111

Technology Crosscut

- Activities continued at a reduced level of effort -826

University Coal Research

- Award one additional innovative concept Phase-1 grant +55

HBCUs, Education and Training

- Activities continue at current level of effort +19

Total Funding Change, Advanced Research	-7,715
--	---------------

Distributed Generation Systems

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
Distributed Generation Systems					
Fuel Cells	59,107	68,644	23,000	-45,644	-66.5%
Novel Generation	2,927	2,469	0	-2,469	-100.0%
Total, Distributed Generation Systems	62,034	71,113	23,000	-48,113	-67.7%

Description

The objectives of the Distributed Generation Systems Fuel Cell activity are to provide the necessary technology base development of fuel cell systems for electric utility, industrial, and commercial/residential markets; and to provide technologies that improve U.S. international competitiveness in this new manufacturing industry.

Benefits

Fuel cell modules in IGCC and FutureGen systems have the potential to double the efficiency of coal-based systems and achieve near-zero emissions. Fuel cells can concentrate CO₂ which lends itself to removal by separation or other capture means. Fuel cells provide a bridge to the hydrogen economy by using coal derived hydrogen to produce power efficiently and by offering the potential to produce hydrogen, as well as electricity, from coal.

Background

Fuel cells and other innovative power systems are being developed for distributed generation applications that can create public benefits by enhancing the overall efficiency, security and reliability of the Nation's energy supply. The Fuel Cells Program supports the President's climate change goals by increasing the efficiency of electricity production, creating the potential for over 50% reduction in CO₂. It supports the Clear Skies Initiative with near zero NO_x, SO_x, and mercury emissions, and it supports energy security goals distributed generation alternatives to grid-based power and through multi-fuel capability (less dependence on one fuel). High-temperature fuel cells can operate on hydrogen and hydrogen carriers such as methane and syngas. Low-cost, ultra-high efficiency, fuel flexible, integrated fuel cell/turbine hybrids systems for snynfuel and hydrogen-based plants will provide essential power modules for FutureGen projects and concepts in the 2010 to 2015 time frame. Hence, the Distributed Generation Program is a bridge to the hydrogen economy of the future envisioned in the FreedomCAR and Hydrogen Fuel Initiatives.

Distributed generation complements electricity supply from central generation systems, by providing another source of energy through smaller-scale production of electric power in stationary plants at or

near the end user. Fuel cells as small modular resources may be used on a stand-alone basis, or integrated with other generators, and even connected to a central system grid. These systems may be owned and/or operated by utilities, utility customers, and third parties. Fuel cell systems are capable of reducing criteria pollutants well below current New Source Performance Standard levels, reducing non-criteria pollutants such as CO₂ and acid rain precursors, and reducing thermal emissions to the environment. Fuel Cells systems provide important carbon management options because of their inherently low emissions and ultra-high efficiency, and significant water conservation options because they can be operated in areas where water resources are scarce.

Fuel cell applications in distributed generation systems offer potential opportunities for cost-effectively meeting peak demand without the need for costly investments in transmission and distribution. They can be used to provide clean power to remote end users; and can provide new business opportunities in both utility and non-utility owners.

The Fuel Cells Program is leveraging technical innovation to develop advanced power systems for distributed generation that will improve power quality, boost system reliability, reduce energy costs, and help delay/defer capital investments. The program goal is to develop low-cost, high efficiency, fuel flexible, modular power systems with lower cost, higher quality electricity, and significantly lower carbon dioxide emissions than current plants, as well as near-zero levels of pollutants.

The current strategy is to develop clean high efficiency fossil fueled powerplants: Immediate near-term (2005-2006) - develop and conduct initial proof-of-concept tests of the Solid State Energy Conversion Alliance (SECA) low-cost, 3-10 kilowatt solid-state fuel cell modules for distributed and auxiliary power unit applications; Mid-term (2007-2010) - develop and test SECA fuel cell prototype modules capable of manufacture of \$400 per kilowatt (a ten-fold reduction from today's cost), and develop combined cycle \$400 per kilowatt gas-based fuel cell/turbine hybrids under Vision 21 Hybrids that will enable the design of synfuel and hydrogen-fueled hybrid powerplants; Long-term (2010-2015) - develop and demonstrate the critical high risk technology advancements which will permit U.S. industry to establish commercial availability of advanced, low-cost, ultra-high efficiency, fuel flexible, integrated fuel cell/turbine hybrids systems for synfuel and hydrogen-based plants. Fuel cell systems have specifically identified goals which coincide with coal-based and other fuel-flexible Vision 21 power modules and concepts in the 2010 to 2015 time frame.

Currently, the Advanced Research subactivity within the Fuel Cell program supports the program objectives by conducting research to identify new, highly innovative electrochemical technology concepts and by solving fundamental crosscutting high-temperature electrochemical issues through the High Temperature Electrochemistry Centers (HiTec) at PNNL and Montana State University.

Currently, the Fuel Cell/Turbine Hybrids subactivity under Vision 21 provides a alternative options for deploying fuel cell systems in a variety of applications. Integration into a single system lowers system costs and increases system efficiency. Hybrid power modules are expected to be a key enabling technology for long-term FutureGen and Vision 21 systems. Hybrid power modules are important element of the Department's hydrogen initiative and strategies for carbon management.

The Innovative Concepts subactivity includes the Solid-State Electricity Conversion Alliance (SECA), the Department's major initiative for stationary fuel cells development. The objective of the SECA is to drastically reduce fuel cells costs to make them a broadly applicable and more widespread commodity in the competitive, mature distributed generation and auxiliary power markets. The SECA program incorporates an integrated strategy to address the technical barriers of solid-state fuel cell systems within the cost constraint of \$400 per kilowatt for a complete system. The benefits of SECA are projected by NEMS to include \$15 billion saving through Clear Skies and Climate Change emissions reductions by 2025 from 50 GW of SECA fuel cell capacity. Additional management benefits can be expected to accrue with the introduction of SECA hybrid systems. Work under SECA core program includes, gas processing (reforming and cleanup), power electronics, controls and diagnostics, heat recovery, modeling and simulation, and material and manufacturing/fabrication research at universities and national laboratories. SECA industry teams are engaged in the development of common modules for diverse applications in multiple and mobile market applications. SECA includes exploration of designs that combine functions to reduce size, weight, and costs.

The Fossil Energy R&D program is committed to searching for promising new ideas for low-cost, low-pollutant power generation. In recent years, Fossil Energy R&D has funded research on the Ramgen engine, an innovative power systems technology under the Distributed Generation Systems Novel Generation Concepts activity. The Ramgen system is capable of utilizing a variety of fuel gases including waste gases, and components of Ramgen show potential for adaption to other power systems.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Fuel Cells	59,107	68,644	23,000

The focus of the Fuel Cells program is to reduce cost by an order of magnitude enabling the widespread deployment of clean reliable fuel cells and fuel cell hybrids for distributed generation, FutureGen, and Vision 21 applications through low-cost, ultra-clean, and ultra-high efficiencies.

Advanced Research.....	3,389	9,876	0
• Advanced Research	3,354	9,778	0

In FY 2005, no additional work is planned in this category. DOE considers these technologies at a point of development where industry can pursue their commercial development without further Federal funding.

In FY 2004, fund research to develop a fundamental understanding of processes that limit the performance of high temperature electrochemical systems. Such systems have applications in fossil energy conversion, energy storage, and electrolysis. Parallel experimental and modeling activities, research conducted by HiTEC will eventually lead to new concepts and technologies in fossil fuel utilization. *Participants to be determined.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

FY 2003 funding continued generic research to capitalize on the intrinsic high efficiency and environmentally benign characteristics of advanced electrochemical technology. Research will be conducted to identify new highly innovative electrochemical technology concepts and to solve fundamental crosscutting issues. *Participants included: ANL, PNNL.*

• Program Support	35	98	0
--------------------------------	-----------	-----------	----------

Fund technical and program management support.

Fuel Cell Systems	9,675	10,865	0
--------------------------------	--------------	---------------	----------

• Fuel Cell Systems	9,576	10,757	0
----------------------------------	--------------	---------------	----------

In FY 2005, no additional work is planned in this category. DOE considers these technologies at a point of development where industry can pursue their commercial development without further Federal funding.

In FY 2004, with the conclusion of molten carbonate fuel cells stack development in FY 2003, this subactivity will support advanced fuel cell systems development and testing in a variety of crosscutting areas in FY 2004.

FY 2003 funding continued cost-shared cost reduction and performance improvement on one full molten carbonate system for market entry by the private sector; continue supportive distributed generation infrastructure, economic and market study assessments and system assessments and evaluations. *Participants included: FCE.*

• Program Support	99	108	0
--------------------------------	-----------	------------	----------

Fund technical and program management support.

Vision 21 Hybrids	13,062	12,840	0
--------------------------------	---------------	---------------	----------

• Vision 21 Hybrids	12,928	12,712	0
----------------------------------	---------------	---------------	----------

In FY 2005, no additional work is planned in this category.

In FY 2004, conduct a redirected Vision 21 enabling cost reduction and performance enhancement program with low-cost Vision 21 fuel cell/turbine hybrid technologies; explore Vision 21 zero-emissions system concepts; conduct system studies and explore fuel flexibility and integration issues as permitted. *Participants include: NETL, GE, FCE, Siemens.*

FY 2003 funding continued a Vision 21 enabling cost reduction and performance enhancement program with Vision 21 fuel cell/turbine hybrid technologies, such as the tubular SOFC hybrid; conduct system studies and explore fuel flexibility and integration issues as permitted. *Participants included: SWPC, NETL, GE, FCE.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

- **Program Support**..... **134** **128** **0**

Fund technical and program management support.

Innovative Systems Concepts..... **32,981** **35,063** **23,000**

- **Innovative Systems Concepts** **32,643** **34,712** **22,770**

In FY 2005, begin prototype validation of Phase I technical requirements for low-cost SECA fuel cell systems; enhance individual components and systems performance; conduct SECA core technology R&D to resolve crosscutting technical issues; develop innovative reformers, sensors, and controls; initiate designs of coal-derived gas-based SECA systems as permitted. *Participants include: GE, Siemens Westinghouse, Delphi, FCE/MRI, Acumentrics, Cummins-SOFC, PNNL, ANL, NETL, and other core technology participants.*

In FY 2004, **SECA** - Develop four concept designs for prototype mid- to high-temperature low-cost solid state fuel cell systems; develop SECA core technology for materials to reduce manufacturing costs, enhance performance, and develop innovative sensors and converters; initiate designs of hybrid coal-based SECA systems. *Participants include: GE/Honeywell, Siemens Westinghouse, FCE/Versa Power, Acumentrics, Delphi, Cummins-SOFC, ANL, PNNL, NETL, and other core technology participants.*

FY 2003 funding continued the mid- to high-temperature low-cost SECA solid state fuel cell program; fund multiple SECA industrial teams and a core technology program; conduct coal-based SECA-hybrid integration studies as permitted. *Participants included: McDermott, ADL, NL, NETL.*

- **Program Support**..... **338** **351** **230**

Fund technical and program management support.

Novel Generation **2,927** **2,469** **0**

In FY 2005, no additional work is planned in this category. DOE considers these technologies at a point of development where industry can pursue their commercial development without further Federal funding.

- **Supporting Technologies** **2,897** **2,444** **0**

In FY 2005, no additional work is planned in this category.

In FY 2004, continue to openly solicit new fossil-fuel based power generation technology that shows promise of improving efficiencies and/or lower emissions through the novel concepts program. *Participants to be determined.*

FY 2003 funding was used to issue a solicitation for novel generation systems.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

• Program Support	30	25	0
Fund technical and program management support.			
Total, Distributed Generation Systems	62,034	71,113	23,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Fuel Cells

Advanced Research

• In FY 2005, no additional work is planned in this category	-9,778
• Program Support	-98
Total, Advanced Research	-9,876

Fuel Cell Systems

• In FY 2005, no additional work is planned in this category	-10,757
• Program Support	-108
Total, Fuel Cell Systems	-10,865

Vision 21 Hybrids

• In FY 2005, no additional work is planned in this category	-12,712
• Program Support	-128
Total, Vision 21 Hybrids	-12,840

Innovative Systems Concepts

• Decrease in Innovative Systems Concepts due to FutureGen funding priorities	-12,012
• Program Support	-121
Total, Innovative Systems Concepts	-12,063

Novel Generation

• In FY 2005, no additional work is planned in this category	-2,444
• Program Support	-25
Total, Novel Generation	-2,469
Total Funding Change, Distributed Generation Systems	-48,113

U.S./China Energy and Environmental Center

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	\$ Change	% Change
U.S./China Energy and Environmental Center	0	988	0	-988	-100.0%
Total, U.S./China Energy and Environmental Center	0	988	0	-988	-100.0%

Description

The U.S./China Energy and Environmental Technology Center (EETC) is co-funded by the DOE and China's Ministry of Science and Technology. The EETC works to facilitate the export of American goods and services to China's growing power industry, with its focus on increasing the market share of U.S. clean coal technologies.

Benefits

China's growing power industry represents a potential market for U.S. goods and services running into the billions of dollars. The adaptation of U.S. clean coal technologies can, in addition to generating export revenue, minimize the global environmental impact of China's growth.

Detailed Justification

(dollars in thousands)		
FY 2003	FY 2004	FY 2005

U.S./China Energy and Environmental Technology Center

0 988 0

No funding is requested for this activity in FY 2005. It is anticipated that activity will continue into FY 2005 with existing funding.

In FY 2004, the EETC has a baseline set of activities that includes maintenance of its facilities, support of industrial partners meetings and activities related to the U.S./China Fossil Energy Protocol, and emissions reductions in China. Two industrial partners meetings will be held in FY 2004, one in February 2004, and the other in the summer of 2004. The summer meeting will include plant tours for Chinese attendees, where they will observe U.S. clean coal technologies in commercial operations. In FY 2004, the EETC is assisting in a study that will result in NO_x reductions from China's largest thermal power plant. Toward this end, the EETC is providing information to plant management on the performance of NO_x control technologies, including those that were developed and demonstrated under the Clean Coal Technology Program. Additionally, the EETC is assisting its

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Chinese partners in the development of a coal quality management plan for the City of Beijing. Beijing will use the results of this plan in the implementation of its planned air quality improvement program which is being undertaken prior to the 2008 Olympic Games. This project is part of an overall EETC program to adapt U.S. techniques for the reduction of emissions from industrial and municipal heating plants in China. These plants emit hundreds of millions of tons of CO₂ annually.

In FY 2003, the EETC maintained its baseline activities. Two meetings of industrial partners were held. This activity was funded under the Clean Coal Technology Appropriation.

**Total, U.S./China Energy and Environmental
Technology Center**

0	988	0
----------	------------	----------

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

U.S./China Energy and Environmental Center

It is anticipated that activities will continue into FY 2005 with existing funds	-988
--	------

Total Funding Change, U.S./China Energy and Environmental Center	-988
---	-------------

Natural Gas Technologies

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Natural Gas Technologies	45,860	42,994	42,994	26,000	-16,994	-39.5%
Total, Natural Gas Technologies	45,860	42,994	42,994	26,000	-16,994	-39.5%

Mission

This program will develop policies and new technologies that stimulate a diverse supply of natural gas - both in North America and around the world so that the market can function to the benefit of all Americans.

Benefits

Each year Fossil Energy estimates the benefits of program activities to support Government Performance and Results Act (GPRA) reporting. Methods are complex and vary by program. The oil and Gas Programs have traditionally used two separate economic and engineering modeling systems to calculate selected economic and energy security benefits. In 2002, a two-year effort, involving external peer review, was begun to integrate these two separate modeling systems into one system for improved simulation of resource and market conditions, and consistency of technology assumptions and model outputs. Under the previous two model systems, deficiencies, such as the assumption of unlimited industry capital availability, could result in an overestimation of industry's response to DOE's R&D products. Conversely, deficiencies, such as only modeling upstream R&D activities and not calculating the synergistic benefits of oil and gas R&D efforts, could result in an underestimation of the benefits of DOE's programs.

The new model will provide the following expected benefits:

- Complimentary technology development in oil and gas research.
- Full R&D program activities can be modeled.
- Ability to calculate synergistic benefits of the oil program on gas production and the gas program on oil production.

As part of the effort to conform to the President's Management Agenda in a shorter-term, Fossil Energy has undertaken an integrated program benefits analysis of oil, natural gas, coal and power systems research within Fossil Energy to develop Fossil Energy-wide program benefits estimates. This analysis, using the Energy Information Administration National Energy Modeling System (NEMS), is examining all Fossil Energy research programs on a common basis with respect to modeling assumptions and should enable aggregate and comparative assessments of the benefits of Fossil Energy research

programs. This spring, a complete explanation of methodology and assumptions will be posted on the Department's website.

Background

Natural Gas is the cleanest burning fuel, and we rely on it to provide a quarter of our Nation's energy needs. However, wide fluctuations in prices and concerns for adequate supplies have been directly responsible for the loss of American jobs.

This program supports three Presidential initiatives. Clear Skies, Climate Change, and energy security provide the underpinning for the Natural Gas Technologies program.

Clear Skies and Climate Change: Growing supplies of natural gas are required to meet the increased demand for electric generation and other residential and industrial use. A primary reason for this demand is that electricity generators can competitively meet increasingly more stringent environmental emissions, including the Clear Skies goal, provided natural gas remains abundant and therefore affordable. Through technology and policy options, the program will provide clean, abundant, affordable natural gas in support of these Presidential initiatives.

Energy Security: The natural gas technologies program goal provides technology and policy actions to increase domestic fuel supplies, expand import/export options, and assure reliable, and secure transmission, distribution, and storage infrastructures.

To meet the increasing U.S. demand for natural gas (AEO 2004 expects present use of 22.8 Tcf to grow to 31.4 Tcf by 2025, an almost 40% increase) at stable and affordable prices, new supplies must be found. Sources of North American natural gas are extensive, but much of it is uneconomic to find and produce. Technology is the key to producing this resource economically.

Natural Gas Exploration and Production-Sustainable Supply program will provide new tools and technologies that can improve access, economics and environmental performance of onshore and offshore gas operations. Significant emphasis will be placed on public lands in the Rocky Mountain region where much of the nation's undiscovered gas resource is located.

Natural gas storage will also assume increasing significance as more power plants require consistent, year-round supplies of natural gas. A nationwide, industry-led consortium will develop ways to improve the reliability and efficiency of the nation's gas storage system.

The program will also work to facilitate Liquefied Natural Gas (LNG) importation. Natural gas supply can be increased through liquefied natural gas (LNG) imports, which can respond readily to demand swings. The global gas industry and domestic consumers will benefit through an association of value chain participants who can openly and freely exchange both technical and market information.

Gas Hydrates: Over the long-term, the production of natural gas from the U.S.'s vast deposits of methane hydrates, which is the program goal, could strengthen energy security. Understanding hydrates can also improve the scientific understanding of greenhouse gases and possibly offer future mechanisms for sequestering carbon dioxide. In the near-term, implications for drilling or producing oil and gas near

or through hydrate formations must be understood to avoid significant environmental damage that could occur with conventional oil and gas operations.

Effective Environmental Protection-Environmental Science: Improved technology and policy will facilitate increased access to Federal and environmentally sensitive lands. The environmental science program includes a focus on issues constraining produced water from coalbed methane production.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Coal and Other Power Systems program supports the following goal:

Energy Strategic Goal

General Goal 4: ENERGY SECURITY: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Natural Gas Technologies program has one program goal which contributes to General Goal 4 in the "goal cascade".

Program Goal 04.56.00.00: Natural Gas Technologies, Abundant Affordable Gas: The Natural Gas Technologies' goal is to provide technology and policy options capable of ensuring abundant, reliable, and environmentally sound gas supplies.

Contribution to Program Goal 04.56.00.00 Natural Gas Technologies, Abundant Affordable Gas

The Program Goal will support General Goal 4 through three long-term goals that increase the amount of gas available to the domestic consumer and support the transition to the hydrogen economy. Benefits from these long-term goals are based upon the target funding level. Benefits from natural gas environmental funding are combined with benefits from the oil environmental funding and reported with the oil program.

- Over the planning horizon (2003-2015), program efforts through public-private partnerships will add 50 Tcf of economically recoverable natural gas resources to domestic supply resulting in a cumulative cost savings of \$85 billion by lowering the price of natural gas. Annually, the National Energy Modeling System (NEMS) will be used to assess the cost savings associated with abundant gas supply.
- Over the planning horizon (2003-2025), program efforts will add 22 Tcf of technically recoverable methane hydrates to the gas resource base.

The key to affordable natural gas in a rising demand environment is increasing supply, and the key to increasing supply is technology coupled with appropriate policy. The program will work in public-private partnerships with industry, universities, and other stakeholders to develop technologies to increase the supply of natural gas through technology and policy.

Annual targets for the gas supply target will track advances in key technology areas like advanced drilling, stripper-well production, and storage. Roughly half of the program's projects are successful. Based upon modeling considerations, four successful projects are sufficient to keep the program on target. Successful projects decrease cost of production and/or increase efficiency of finding gas. Either increases the economically recoverable natural gas resource. When this technology is implemented by industry, the production (supply) of natural gas increases and the price of natural gas likely declines. The price drop results in a cost savings to the consumer.

Annual targets for the methane hydrates will track critical progress in key program areas including resource characterization and safety and seafloor stability that will eventually led to identification of technically recoverable resources.

The program's performance measures will be tracked on a quarterly basis using DOE's JOULE Performance Measures system. In this system the quarterlies will roll up to the annuals and the annuals will roll up to the Program Goal. To date, the program has received perfect scores on its FY 2003 performance measures.

The key to affordable natural gas in a rising demand environment is increasing supply in an environmentally acceptable manner. The key to increasing supply is a balanced policy and technology initiative focused on expanding the gas supply from key regions in the U.S., and diversifying the supply portfolio through increased imports. The program will work in public-private partnerships with industry, universities, and other stakeholders to develop policies and technologies to increase the supply of natural gas.

The program's performance measures will be tracked on a quarterly basis using DOE's JOULE Performance Measures system. In this system the quarterlies will roll up to the annuals and the annuals will roll up to the Program Goal.

.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY2002 Results	FY 2003 Results	FY 2004 Targets	FY2005 Targets
Program Goal 04.56.00.00 Natural Gas Technologies, Abundant Affordable Gas					
Exploration and Production					
Demonstrate a cost-effective horizontal well and advanced exploration and stimulation technologies in low permeability natural gas formations for increasing recovery of the 5,000+ TCF of gas in place in the Greater Green River and Wind River Basins. (NEARLY MET GOAL)		<p>Demonstrate safe economic slimhole drilling technology in actual use under Arctic conditions. This technology can significantly reduce cost and environmental impacts. (MET GOAL)</p> <p>Develop and demonstrate two technologies to detect and quantify areas of high fracture density in currently uneconomic low permeability gas reservoirs. This program has the near-term commercial potential to double average per-well productivity. (MET GOAL)</p>	<p>Complete basin model for the Wind River basin and well site selection in Greater Green River Basin to evaluate integrated remote sensing, seismic surveys and basin structural analysis to differentiate gas-bearing from uneconomic fractured reservoirs, complete a conceptual model of regional water distribution to help operators avoid poor production areas, and build and have field ready an initial prototype of a 400-geophone receiver array to improve seismic resolution necessary to locate economically productive gas zones. (MET GOAL)</p> <p>Conduct 2 field tests of improved drilling technology that will improve the productivity of gas reservoirs and reduce drilling costs and 2 field tests of technologies to improve natural fracture detection to increase the percentage of economically producing wells of all wells drilled. (MET GOAL)</p>	<p>Conduct laboratory studies and feasibility analyses necessary to justify the next stage of R&D for a drilling vibration monitoring and control system, a novel mud hammer, high-temperature high-pressure cements, gas resources in the Uinta and Anadarko basins, and high-temperature electronics. This is accomplished by completing prototype development and validation testing of data fusion algorithms, a power amplifier, and simulating software for fractured reservoirs prior to field trials.</p> <p>Complete field tests and analysis of stripper well technologies, a jet assisted drilling system, advanced fracture stimulation designs, natural fracture predictions, and downhole power and communications systems to determine the overall technical and cost efficiency of the technology and the next step(s) to be taken, i.e., commercialization, additional modifications and testing, or termination.</p>	<p>Complete four of the prototype near-term products or field tests from three critical technology areas: advanced drilling, stripper-well enhancement, and gas storage. When these technologies are fully transferred to industry, they will substantially reduce costs or increase efficiency in gas exploration, production and storage. The prototype projects can be found on the program's website. Based on modeling estimates.</p>
Gas Hydrates					
Identify a site containing gas hydrates suitable for testing the feasibility of methane recovery. (MET	Quantify a hydrate deposit by correlating core samples with geophysical and well log data. (MET GOAL)		Exchange information and coordinate effort between government agencies. Award subprojects under Joint Industry Projects for	Hold interagency meetings to exchange hydrate information and coordinate hydrate efforts between government agencies; issue	

FY 2000 Results	FY 2001 Results	FY2002 Results	FY 2003 Results	FY 2004 Targets	FY2005 Targets
GOAL)			<p>Gulf of Mexico seafloor stability and monitoring programs. Issue newsletters, publish available technical reports on the methane hydrate website, and hold 2 workshops to communicate program results to researchers. Conduct annual Federal Advisory Committee meeting. (MET GOAL)</p> <p>Complete hydrate modeling for Alaska drilling program. Report strength and thermal property tests at national labs, this is fundamental data needed to model production and seafloor stability of hydrates. Develop prototype Raman Spectroscopy to use lasers to define hydrate molecular structure. (MET GOAL)</p> <p>Complete initial report of improved hydrate coring device on Ocean Drilling Program, Leg 204. Study of oceanic samples is essential to understanding the distribution and properties of hydrates in nature. Drill 1 test well to determine aerial extent of hydrate occurrence in Alaska. Complete evaluation of hydrate occurrence in Gulf of Mexico to understand the interaction of hydrate and seafloor stability. (MET GOAL)</p>	<p>newsletters; and hold workshops to communicate program results to stakeholders.</p> <p>Complete laboratory analysis of core samples from the Malik research well and the Hot Ice No. 1 well, thermal property and thermal conductivity measurements, and complete installation of a 12-liter hydrate cell to obtain the necessary data for modeling and characterizing hydrate deposits.</p> <p>Complete field tests of hydrate logging and coring operations in the Gulf of Mexico, and drilling and coring Hot Ice No. 1, and analyze results and publish reports on ODP leg 204 and Malik well to advance our understanding of seafloor stability and production potential.</p>	<p>Conduct an ocean expedition to retrieve gas hydrate samples for laboratory analysis. This will increase the understanding of sub-sea resources, which is a prerequisite for development of safe production technologies.</p>

FY 2000 Results	FY 2001 Results	FY2002 Results	FY 2003 Results	FY 2004 Targets	FY2005 Targets
-----------------	-----------------	----------------	-----------------	-----------------	----------------

Infrastructure

Complete laboratory testing and begin field demonstration of an improved remedial technology for storage wells. (MET GOAL)

Conduct 4 field tests to demonstrate technical feasibility of advanced remote sensing and pipeline inspection technologies to reduce unintentional damage and increase pipeline integrity. Complete 2 field tests for underground gas storage facilities to improve gas storage well deliverability. Complete field testing of energy meter prototype.

Effective Environmental Protection

Analyze results of bench-scale reverse osmosis in produced water treatment equipment. Develop kinetics for model compounds to be used in enzymatic and biomimetic catalysts for upgrading heavy crude oils. Construct greenhouse prototype for phytoremediation for methane (natural gas) from coal beds (CBM) water. Collect data on fine particulate matter emission factors. These studies will provide the scientific basis for lower-cost commercial-scale environmental technologies. (MET GOAL)

Ensure that refining and gas production and use are safe for the environment and the public by conducting field tests and data analysis for remediation, produced water treatment, and synthetic mud technologies. Also preparing baseline characterization of impacts of Wyoming and Montana coalbed methane (gas from coal seams) production on groundwater systems and utilizing laser-coupled technology to identify natural gas distribution system leaks.

Efficiency Measure: Meet the procurement plan metric which requires successfully completing greater than 90 percent of the procurement milestones (e.g., solicitation

FY 2000 Results	FY 2001 Results	FY2002 Results	FY 2003 Results	FY 2004 Targets	FY2005 Targets
					issue date, proposal ranking deadline, signing of selection statement, Congressional notification, making awards, etc.).

Means and Strategies

Three Presidential initiatives: Clear Skies, Climate Change, and energy security provide the underpinning for the Natural Gas Technologies program. These initiatives form the basis for the program strategy: (1) protecting the environment through enhanced design and efficiency of domestic natural gas exploration, production, transport, and storage operations; (2) supporting technology paths that private companies cannot risk undertaking alone; (3) providing scientific and technological information and analysis to assist policymakers in their decision-making; and, (4) optimizing environmental protection by contributing to science-based improvements in regulations that reduce uncertainties and costs.

The Natural Gas Technologies program will use various means and strategies to achieve its program goals. However various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals.

The strategies related to increasing domestic supplies are achieved by: increasing recovery through lower cost drilling, wellbore improvements, and improved stimulation technology; improving geoscience technologies to locate and measure gas within reservoirs; extending the life of mature gas fields and reducing well abandonments; and modeling estimates of potential economic recovery of domestic gas through a range of technologies, economic criteria, and legislative and regulatory scenarios.

Validation and Verification

The program is a major supporter of DOE's performance measures tracking system (JOULE) and has pioneered many of the system's tracking and reporting tools. GPRA reporting requirements are handled through the JOULE system, and the program has also used the same software JOULE to track performance on a number of additional measures covering the full breath of the program's activities (FE JOULE) including efforts to track the status of key outreach milestones into JOULE. In FY 2003, the program got to and stayed at "Green."

To validate and verify program performance, FE will conduct various internal and external reviews and audits. FE's programmatic activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. Each year, the Office of Engineering and Construction Management conducts external independent reviews of selected projects. In addition, various Operations/Field Offices commission external independent reviews of site baselines or portions of the baselines. Additionally, FE Headquarters senior management and Field managers conduct quarterly, in-depth reviews of cost, schedule, and scope to ensure projects are on-track and within budget.

Collaboration Activities: The impact of the Domestic Gas Supply program is expanded by: performing R&D activities in partnership with universities, State and local governments, industry, and other stakeholders; using cost-share projects and diverse technology paths to improve chances of success, and to create a direct technology transfer component; seeking synergy of the capabilities of multiple governmental agencies and industry, including the unique capabilities of National Laboratories; collaborating with other agencies to effectively promulgate domestic production technologies; investing jointly with other groups in promising technologies for target resource areas; conducting, with input

from National Laboratories, field demonstrations in collaboration with industry, academia, and others; and transferring technologies in cooperation with State and industry organizations.

External Factors Affecting Performance: Access to public land is the single most important factor impacting the supply of domestic natural gas. Additional factors include world oil prices, corporate mergers and acquisitions, availability and cost of capital, and new and evolving environmental legislation and regulation may affect gas program results.

Planned Program Evaluation: The Office of Natural Gas and Petroleum Technology annually performs an internal review of the R&D portfolio as an integral part of annual budget preparation. Projects are evaluated periodically at contractor review conferences and as part of road-mapping workshops to determine R&D gaps. National Energy Technology Laboratory (NETL) product managers individually monitor projects with status and major milestone reporting documented in a NETL project database. NETL in-house R&D projects are peer reviewed by external experts from academia and industry. DOE has recently developed specific metrics to better quantify and value R&D results. In addition, program benefits are estimated using the National Energy Modeling System (NEMS) supported by macroeconomic and detailed industry-specific models. Modeling assumptions and methods are reviewed externally, and the results are compared to results from other programs to determine the best application of R&D resources. Headquarter and field teams have been established to insure close cooperation in the implementation of performance measure and benefit calculations.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Gas Technologies program has incorporated feedback from OMB into the FY 2005 Budget Request and has taken or will take the necessary steps to continue to improve performance.

Assessment under PART found the program was ineffective and lacks a vigorous peer review. Its annual and long-term measures have been agreed upon, but modeling assumptions need to be made more transparent.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.56.00.00, Natural Gas Technologies, Abundant Affordable Gas					
Exploration and Production.....	22,712	22,203	17,500	-4,703	-21.1%
Gas Hydrates	9,218	9,383	6,000	-3,383	-36.1%
Infrastructure	8,780	8,939	0	-8,939	-100.0%
Emerging Processing Technology	2,593	0	0	0	0.0%
Effective Environmental Protection.....	2,557	2,469	2,500	+31	+1.3%
Total, General Goal 4 (Natural Gas Technologies)	45,860	42,994	26,000	-16,994	-39.5%

Natural Gas Technologies

Funding Schedule by Activity

(dollars in thousands)

	FY PY	FY CY	FY BY	\$ Change	% Change
Natural Gas Technologies					
Exploration and Production	22,712	22,203	17,500	-4,703	-21.1%
Gas Hydrates.....	9,218	9,383	6,000	-3,383	-36.1%
Infrastructure	8,780	8,939	0	-8,939	-100.0%
Emerging Processing Technology	2,593	0	0	0	0.0%
Effective Environmental Protection	2,557	2,469	2,500	+31	+1.3%
Total, Natural Gas Technologies	45,860	42,994	26,000	-16,994	+39.5%

Detailed Justification

(dollars in thousands)

FY 2003	FY2004	FY 2005
---------	--------	---------

Exploration and Production..... 22,712 22,203 17,500

In FY 2005, this program will continue develop technologies that will overcome major market and technological barriers to increase domestic supply of natural gas at reasonable prices without harm to the environment.

▪ **Sustainable Supply..... 0 0 12,375**

In FY 2005 the program will focus on resources in high-priority regions to find and produce gas from non-conventional and deep gas reservoirs with minimal environmental impact. Deep Trek projects for EM telemetry, microwave drillpipe, advanced diamond cutters and fluid systems will complete field testing. Deep Trek projects for high temperature electronics, super cement, and advanced MWD will complete prototype development. Projects selected under the FY 2004 Deep Gas Imaging and Technologies for Tight Gas Solicitation will continue. DOE will continue the long-term sustainability program and

(dollars in thousands)

FY 2003	FY2004	FY 2005
---------	--------	---------

complete ongoing projects in advanced diagnostics and imaging, and drilling completion and stimulations.

DOE will continue the National Stripper Well Consortium involving industry and the research community to investigate multiple technologies to improve stripper well production and prevent the abandonment of 8% of total U.S. production. In addition, DOE will support industry-led efforts in technology transfer through workshops and publications focused on the small- to mid-sized independents.

To assure efficient and reliable availability of natural gas to end users, DOE will continue funding a National, industry-driven consortium in gas storage (similar to the Stripper Well Consortium), to improve the reliability and efficiency of the existing storage system. In addition, DOE will conduct two research projects to develop advanced sensors for plastic and metal pipes.

Participants include: Honeywell, Schlumberger, E-Spectrum, Cementing Solutions, Hart Publications, PTTC, PSU, ACPT, Terra Tek, CSI, GTI, E2S, NETL, State of California, TBD.

In FY 2004 and FY 2003, project activities were funded in other key activities, below

- | | | | |
|--|--------------|--------------|----------|
| ▪ Advanced Drilling, Completion and Stimulation . | 9,870 | 9,876 | 0 |
|--|--------------|--------------|----------|

No activity in FY 2005. Technologies for advanced drilling and drilling greater than 15,000 feet included in Sustainable Supply above.

FY 2003 and FY 2004 funding continued development of real-time fracture height growth diagnostic tool, ultra-light weight cement for deep water applications, high-pressured coiled tubing drilling system, mud hammer, long-term, revolutionary technologies such as laser drilling and perforations, technologies for drilling deeper than 16,000 feet including high performance drilling and completion systems, advanced coatings and hardening of "Smart" systems and sensors. *Participants included: NETL, Novatek, Mauer, Tempress, Tech Int., Cementing Solutions, Real-Time Zone, Terra Tek, GTI, TBD*

- | | | | |
|---|--------------|--------------|----------|
| ▪ Advanced Diagnostics and Imaging Systems | 3,964 | 3,952 | 0 |
|---|--------------|--------------|----------|

No activity in FY 2005. Advanced Diagnostics and Imaging Systems are combined under Sustainable Supply above.

FY 2004 and FY 2003 funding continued development of infill drilling optimization in the San Juan basin and Delaware basin of New Mexico, next generation of fracture detection technologies, long-term sustainability of gas supply study in Rocky Mt. basins, improved completion technologies, solutions to high water production problems in tight sand regions, super high resolution seismic tools and shear wave imaging. *Participants included: NETL, ARI, Stanford, LBL, SUNY, SNL, Paulsson Geophysical, University of Texas, Cementing Solutions, N. Mex. Tech.*

- | | | | |
|--|--------------|--------------|----------|
| ▪ Multi National Laboratory/ Industry Partnership | 1,987 | 1,975 | 0 |
|--|--------------|--------------|----------|

No activity in FY 2005.

(dollars in thousands)

FY 2003	FY2004	FY 2005
---------	--------	---------

FY 2004 and FY 2003 funding continued research in 10 projects focused on advanced drilling, completion, and stimulation technologies and advanced diagnostics and imaging technologies.

- **Secondary Gas Recovery Program** 497 0 0

No activity in FY 2005 or FY 2004.

FY 2003 funding was used to issue a broad based financial assistance competition for secondary gas recovery studies in regions outside of the Gulf of Mexico. *Participants to be determined.*

- **Stripper Well Revitalization** 1,192 1,185 0

In FY 2005, this activity will continue under the Sustainable Supply effort described above.

FY 2004 and FY 2003 funding continued National, industry-driven consortium to investigate multiple technologies to improve stripper well production. *Participants included: Penn St. Univ.*

- **Technology Transfer** 497 494 0

In FY 2005, this activity will continue under the Sustainable Supply effort described above.

FY 2004 and FY 2003 funding continued industry led efforts in technology transfer. *Participants included: PTTC, Hart Publications.*

- **Deep Trek** 1,490 1,481 0

In FY 2005, this activity will continue under Sustainable Supply effort described above.

FY 2004 and FY 2003 funding continued development of technologies for drilling deeper than 16,000feet below the earth's surface, including high performance drilling and completion systems, advanced coatings and hardening of "Smart" systems and sensors, low friction, wear resistant coatings/materials. *Participants included: SNL, Honeywell, Schlumberger.*

- **Liquefied Natural Gas** 0 0 4,950

Increased gas supplied to the market place through LNG imports will reduce the price volatility in the market. In FY 2005, initiatives will be started to complete analyses of the economic impact of LNG supplies in the US gas market, the impact LNG tanker traffic on shipping in U.S. ports, and specific safety and security issues related to the delivery of LNG to terminals in the U.S. A federal agency task force will be established to streamline the LNG terminal approval process. An analysis of the benefits of LNG production vs. flaring will be completed for presentation to nations currently wasting associated gas produced along with oil. *Participants include: Conversion Gas Imports, NYSEG, TBD.*

- **Arctic Research** 2,982 2,964 0

No funding requested for this activity in FY 2005.

FY 2004 and FY 2003 funding supported the Arctic Energy Office and research concerning the natural gas pipeline.

- **Program Support** 233 276 175

Fund technical and program management support.

(dollars in thousands)

FY 2003	FY2004	FY 2005
---------	--------	---------

Gas Hydrates **9,438** **9,383** **6,000**

Gas Hydrates, located in Alaska and the Gulf of Mexico and other offshore locations of the U.S., contain huge resources of natural gas (if only 1% were economically producible, we could triple our resource base). In addition to their potential as a resource, hydrates appear to have implications for the global climate. Significant research is needed to provide the knowledge and technology to understand the fundamental characteristics of hydrates by 2010, and commercially produce gas from hydrates starting in 2015-2020, when more conventional resources decline. Because this research is high risk and long-term, and could potentially lower the value of current reserves, there is little incentive for industry to take the lead in hydrate development.

▪ **Gas Hydrates** **9,124** **9,290** **5,940**

In FY 2005 and FY 2004 the program will support one ongoing joint industry project needed to drill initial coring wells in the Gulf of Mexico in order to assess the potential resource in the Gulf of Mexico. In addition, one Alaska hydrate project funded in FY 2003 will be continued to assess the extent of gas resources locked in hydrate formations in Alaska. Main emphasis will be on taking stratigraphically deep cores from hydrate formations in the Gulf of Mexico. *Participants include: TBD, Chevron Texaco*

FY 2003 funding continued industry-led field activities to drill and collect samples of naturally occurring hydrate from Alaska permafrost for characterization, Joint Industry Project to understand fundamental hydrate issues in the Gulf of Mexico, national lab work and Gulf of Mexico Seafloor Monitoring work.. *Participants included: U. Miss., Chevron Texaco, BP, Maurer.*

▪ **Program Support** **94** **93** **60**

Fund technical and program management support.

Infrastructure **8,780** **8,939** **0**

This program develops technology to ensure the operational reliability and integrity of transmission and utility distribution pipeline systems. The research is focused on five categories: inspection technologies, remote sensing, materials development, operational technologies, and storage. Benefits of the program are expected to be reduced greenhouse methane emissions, increased pipeline capacity, improved pipeline assessment techniques, more efficient pipeline operations, and increased safety and security.

▪ **Storage Technology** **1,940** **1,956** **0**

In FY 2005, this activity has been combined with the Sustainable Supply program described above.

FY 2004 and FY2003 funding was used to continue development of an energy meter, to establish an industry driven underground gas storage consortium, initiate bedded salt and electronic flow meter data modeling efforts, and initiate field testing of critical components of a novel LNG process. *Participants included SwRI, Terralog, Schlumberger, Conversion Gas Imports, Furness-Newbruge, Penn State University.*

(dollars in thousands)

FY 2003	FY2004	FY 2005
---------	--------	---------

- **Delivery Reliability** 6,790 6,845 0

No funding is requested for this activity in FY 2005. See Sustainable Supply above.

In FY 2004 and FY 2003, continue research directed to ensure the reliability and integrity of the gas transmission and distribution network, develop smart automated inside pipeline inspection sensor systems, conduct research on obstacle detection systems for horizontal boring applications for laying distribution pipelines, develop systems capable of detecting external force damage, develop technology to improve the efficiency for reciprocating and turbo compressors, and develop advance technology capable of determining pipeline wall integrity. *Participants included SwRI, Tuboscope, NYGAS, GTI, Battelle, CSU, ARC, ANL, INEEL, LLNL, SNL, ORNL, PNNL, NETL.*

- **Program Support** 50 138 0

Fund technical and program management support.

Emerging Processing Technology 2,593 0 0

- **Coal Mine Methane** 2,566 0 0

No activity in FY 2005 or FY 2004.

FY 2003 funding will complete three existing projects in coal mine methane. Fuel Cell Energy will conduct a demonstration of using a fuel cell to produce electricity from coal mine methane. The funding provided in FY 2003 was sufficient to fully fund all remaining project obligations. One project will likely be active in FY 2005, however, no new funding is requested.

- **Program Support** 27 0 0

Fund technical and program management support.

Effective Environmental Protection 2,557 2,469 2,500

This program seeks to reduce the environmental impacts of gas operations and reduce the cost of environmental compliance through a combination of technology development, risk assessment, and regulatory streamlining. The program will emphasize research that will improve access to onshore public lands.

- **Environmental Science** 0 2,444 2,475

In FY 2005 and FY 2004, conduct targeted initiatives to define and solve specific problems in key focus areas, specifically: 1) environmental barriers to coal bed methane production, and 2) air quality issues affecting natural gas production. Develop objective, credible scientific data for regulatory decisions as part of a program-wide environmental strategy for maintaining sustainable supplies of natural gas. *Participants include: NETL, National Labs, TBD.*

In FY 2003, project activities were funded in separate key activities described below.

- **Program Planning Data and Analysis** 357 0 0

In FY 2005 and FY 2004, activity continued in Environmental Science above.

(dollars in thousands)

FY 2003	FY2004	FY 2005
---------	--------	---------

FY 2003 funding continued data collection and the development of analytical tools for program planning, for outreach and technology transfer, including the capability to quantify environmental costs and assess constraints to gas resource recovery, collection and distribution. Continue to perform legislative and regulatory impact analysis related to both upstream and downstream gas environmental issues. *Participants to be determined.*

- **Technology Development** **993** **0** **0**

Activity continued in Environmental Science above in FY 2005 and FY 2004.

FY 2003 funding continued efforts to develop and demonstrate technologies for improving the environmental performance of all gas exploration and production. *Participants to be determined.*

- **Outreach and Technology Transfer** **1,181** **0** **0**

Activity continued in Environmental Science above in FY 2005 and FY 2004.

FY 2003 funding continued outreach and technology transfer efforts on environmental issues affecting natural gas supply, including compliance efforts with industry, states, and others to identify and address environmental challenges to expanded natural gas production. *Participants to be determined.*

- **Program Support** **26** **25** **25**

Fund technical and program management support.

Total, Natural Gas Technologies	45,860	42,994	26,000
--	---------------	---------------	---------------

Explanation of Funding Changes

FY 2004 vs. FY 2005 (\$000)

Exploration and Production

• Funding in FY 2005 will support research to address critical barriers to the expansion of gas storage and LNG supply. Several ongoing technical projects in drilling and advanced diagnostics and imaging will be terminated. New work will be started in Deep Trek. The National Lab Partnership will be terminated. Arctic Energy Office funding will be eliminated	-4,602
• Program Support	-101
Total, Exploration and Production	-4,703

Gas Hydrates

• Decreased funding in FY 2005 for Alaska project	-3,350
• Program Support	-33
Total, Gas Hydrates	-3,383

Infrastructure

• In FY 2005, most ongoing projects will be terminated	-8,801
• Program Support	-138
Total, Infrastructure	-8,939

Effective Environmental Protection

▪ Continues the program at current year level of effort	+31
Total Funding Change, Natural Gas Technologies	-16,994

Oil Technology

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Petroleum – Oil Technology	40,983	35,078	35,078	15,000	-20,078	-57.2%
Total, Petroleum – Oil Technology	40,983	35,078	35,078	15,000	-20,078	-57.2%

Mission

The mission of the Oil Technology Program is to implement a policy, science and technology development program to resolve the environmental, supply, and reliability constraints of producing and using fossil energy resources. We do this by investing in research with clear and tangible public benefits and by developing policy options. These benefits include a cleaner environment, more secure and stable energy supplies, and increased domestic oil production.

Benefits

Each year Fossil Energy estimates the benefits of program activities to support Government Performance and Results Act (GPRA) reporting. Methods are complex and vary by program. The oil and Gas Programs have traditionally used two separate economic and engineering modeling systems to calculate selected economic and energy security benefits. In 2002, a two-year effort, involving external peer review, was begun to integrate these two separate modeling systems into one system for improved simulation of resource and market conditions, and consistency of technology assumptions and model outputs. Under the previous two model systems, deficiencies, such as the assumption of unlimited industry capital availability, could result in an overestimation of industry's response to DOE's R&D products. Conversely, deficiencies, such as only modeling upstream R&D activities and not calculating the synergistic benefits of oil and gas R&D efforts, could result in an underestimation of the benefits of DOE's programs.

The new model will provide the following expected benefits:

- Complimentary technology development in oil and gas research.
- Full R&D program activities can be modeled.
- Ability to calculate synergistic benefits of both programs.

As part of the effort to conform to the President's Management Agenda in a shorter-term, Fossil Energy has undertaken an integrated program benefits analysis of oil, natural gas, coal and power systems research within Fossil Energy to develop Fossil Energy-wide program benefits estimates. This analysis,

**Fossil Energy Research and Development/
Petroleum - Oil Technology**

FY 2005 Congressional Budget

using the Energy Information Administration National Energy Modeling System (NEMS), is examining all Fossil Energy research programs on a common basis with respect to modeling assumptions and should enable aggregate and comparative assessments of the benefits of Fossil Energy research programs.

Background

Fossil Energy programs have been realigned to support the President's climate change and energy security goals. The Oil Technology Program increases energy security by facilitating environmentally responsible oil and gas exploration and development. The President's National Energy Policy emphasizes that 21st century technology is the key to environmental protection and new energy production.

The program's focus is on areas that require a Federal presence to achieve national energy goals. The budget delineates program goals, such as Enhanced Oil Recovery/CO₂ Injection, Domestic Resource Conservation, and Environmental Science, as funding categories. For example, the President's climate change goal will be met by research and technology development that supports effective management practices of carbon dioxide and other greenhouse gases. CO₂ injection supports this goal by revitalizing domestic energy production while storing carbon. When appropriate, collaborations with other Federal agencies, industry, academia, and states are used to meet program goals.

America's energy security is enhanced by research and technology development to support a vibrant U.S. oil and gas industry that will continue to be the base for global exploration and production. The Oil Technology Program includes research to support solid policy decision-making and technology development to allow greater access to energy resources with minimal environmental impact.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Coal and Other Power Systems program supports the following goal:

Energy Strategic Goal

General Goal 4: ENERGY SECURITY: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Oil Technology program has one program goal which contributes to General Goal 4 in the "goal cascade".

Program Goal 04.57.00.00: Oil Technology, Energy Security: The goal of the Oil Technology program is to enhance U.S. energy security by managing and funding oil exploration and production (E&P) research and policy which results in development of domestic oil resources in an environmentally sound and safe manner

**Fossil Energy Research and Development/
Petroleum - Oil Technology**

FY 2005 Congressional Budget

Contribution to Program Goal 04.57.00.00: Oil Technology, Energy Security

A strong domestic oil resource provides a solid foundation for energy security. The Program accomplishes this goal through the following long-term goal:

- Over the planning horizon (2003-2025), program efforts through public-private partnerships will result in a cumulative economically recoverable reserve increase of 2 billion barrels. The program benefit estimate is based upon the Energy Information Administration's National Energy Modeling Systems (NEMS).

This measure is the cumulative total economically recoverable oil resource added from existing and expected projects. The baseline production is the AEO 2003 Reference case production forecast and price assumptions. Benefits with and without the program will be calculated over the planning horizon via an integrated econometric computer program – the Energy Information Administration's National Energy Modeling System (NEMS). The targets for this measure reflect the cumulative total output through 2025 from the NEMS model analysis. Annually, technology results will be used to update the NEMS parameters to model the program annual outputs and long-term projected outcomes. This analysis is to be repeated retrospectively each year to obtain a comparative actual value reflective of the R&D success. Benefits from natural gas environmental funding are combined with benefits from the oil environmental funding and reported in the oil program.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003Results	FY 2004 Targets	FY 2005 Targets
<p>Complete demonstration and transfer of seven advanced secondary and tertiary technologies, adding 92 million barrels of reserves, increasing the number of economic wells and reducing abandonment rates (MET GOAL)</p> <p>Complete field testing and monitoring of two technologies for downhole separation of oil and water, resulting in reduction in produced water and potential increase in oil production per well. (NEARLY MET GOAL)</p>	<p>Complete demonstration of five advanced secondary and tertiary technologies. Based on models, it is estimated these technologies will increase near-term incremental production by 1.7 million barrels of oil, and long-term incremental production by over 2.4 billion barrels of oil. (NEARLY MET GOAL)</p> <p>Demonstrate the field application of a shoulder-mounted, portable video methane leak detection system that can be used to significantly reduce costs of leak monitoring at refineries and other facilities while reducing harmful air emissions. Annual savings of \$500,000 per year per refinery, on average, would result from regulatory acceptance and application of this technology. (BELOW EXPECTATIONS)</p>	<p>Demonstrate a small-diameter, lightweight composite drill pipe for ultra-short radius drilling. (MET GOAL)</p>	<p>Increase access to the domestic oil resources remaining in the reservoir due to lack of advanced technology. Focus on high risk research (award 6 projects and issue 1 solicitation - Micro-hole technologies) for future applications on state and federal lands and waters, and on addressing nearer-term barriers. Select and award 4 projects with independents, and on a regional basis award 4 projects-PUMP. Award 2 projects in Advanced Technologies and select band award projects under the Broad Funding Announcement. (MET GOAL)</p> <p>Advance the state-of-the-art in oil recovery processes by conducting bench tests (in surfactant behavior, and in paraffin deposition) and develop conceptual models and techniques related to chemical flooding, reservoir and flow simulation, reservoir characterization for enhanced oil recovery technologies to increase the amount of oil that can be recovered from discovered reservoirs (MET GOAL)</p> <p>Reduce the number of dry holes drilled in frontier areas, and increase near-term energy security through field testing (3 projects) improved oil recovery techniques, seismic (1 project), data acquisition (2 projects), and interpretation (1 project) in existing light and heavy oil</p>	<p>Enhance access to remaining domestic oil resources using advanced technology by focusing on high-risk research (award 3 projects—Micro-hole technology); issuing competitive solicitation and awarding three projects. Initiate Russian cooperative Research Program; and conduct model integration peer review and industry strategic program review.</p> <p>Advance the state-of-the-art in oil recovery processes by conducting bench tests in surfactant behavior (2 projects); modeling on-conventional reservoirs, studying gel control of water production, developing seismic algorithms to better identify hydrocarbon targets; testing 2 prototypes (3-phase separator and micro-hole completion), modeling sweep efficiency for enhanced oil recovery technologies to increase the amount of oil that can be recovered from discovered reservoirs, and completing tundra modeling and pond work, conducting wettability studies as well as initiating fracture development study.</p>	<p>Develop technologies through 4 projects which will contribute to increasing domestic oil supplies in an environmentally friendly manner.</p>

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003Results	FY 2004 Targets	FY 2005 Targets
			reservoirs at sites ranging from Alaska to Utah. Initiate full-scale test of newly developed vibration sonic tool. (NEARLY MET GOAL)		
			Stimulate current production through accelerated transfer of technology to U.S. producers, especially small independent companies that have limited exposure to the technology needed to increase the oil resource base through 66 regional workshops, including one on micro-hole technologies, publish 2 newsletters, and 2 reports. (MET GOAL)		

Means and Strategies

Domestic Oil and Gas Supply: Four strategies are the focus of efforts in this program: (1) protecting the environment through enhanced design and efficiency of Domestic oil and natural gas exploration, recovery, processing, transport, and storage operations; (2) supporting technology paths that private companies cannot risk undertaking alone; (3) providing scientific and technological information and analysis to assist policymakers in their decision-making; and, (4) optimizing environmental protection by contributing to science-based improvements in regulations that reduce uncertainties and costs. The strategies related to increasing domestic supplies are achieved by: increasing recovery through lower cost drilling, wellbore improvements, and improved stimulation technology; improving geoscience technologies to locate and measure oil and gas within reservoirs; extending the life of mature oil and gas fields and reducing well abandonment; improving technologies for enhanced oil recovery processes; and modeling estimates of potential economic recovery of domestic oil and gas through a range of technologies, economic criteria, and legislative and regulatory scenarios.

The Oil Technology program will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals.

Validation and Verification

The impact of the Domestic Oil Supply program is expanded by: performing R&D activities in partnership with universities, State and local governments, industry, and other stakeholders; using cost-share projects and diverse technology paths to improve chances of success, and to create a direct technology transfer component; seeking synergy of the capabilities of multiple governmental agencies and industry, including the unique capabilities of National Laboratories; collaborating with other agencies to effectively promulgate domestic production technologies; investing jointly with other groups in promising technologies for target resource areas; conducting, with input from National Laboratories; field demonstrations in collaboration with industry, academia, and others; and transferring technologies in cooperation with State and industry organizations, including the Petroleum Technology Transfer Council (PTTC).

External Factors Affecting Performance:

World oil prices, corporate mergers and acquisitions, issues related to access to public lands, availability of capital, and new and evolving environmental legislation and regulation may affect oil program results.

Planned Program Evaluation:

The Office of Natural Gas and Petroleum Technology annually performs an internal review of the R&D portfolio as an integral part of annual budget preparation. Projects are evaluated periodically at contractor review conferences and as part of road-mapping workshops to determine R&D gaps. National Energy Technology Laboratory (NETL) product managers individually monitor projects with status and major milestone reporting documented in a NETL project database. NETL in-house R&D projects are peer reviewed by external experts from academia and industry. At this time, DOE is developing specific metrics that are applicable to better quantify and evaluate R&D results. In addition, program benefits are

estimated using macroeconomic and detailed industry-specific models. Modeling assumptions and methods are reviewed externally, and the results are compared to results from other programs to determine the best application of R&D resources.

To validate and verify program performance, FE will conduct various internal and external reviews and audits. FE's programmatic activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. Each year, the Office of Engineering and Construction Management conducts external independent reviews of selected projects. In addition, various Operations/Field Offices commission external independent reviews of site baselines or portions of the baselines. Additionally, FE Headquarters senior management and Field managers conduct quarterly, in-depth reviews of cost, schedule, and scope to ensure projects are on-track and within budget.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Oil Technology program has incorporated feedback from OMB into the FY 2005 Budget Request and has taken or will take the necessary steps to continue to improve performance.

Assessment under PART found the program ineffective. The program purpose is well-defined and annual performance measures have been agreed to. However, modeling assumptions need to be made transparent and the program lacks a vigorous peer review process.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	\$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.57.00.00, Oil Technology, Energy Security					
Exploration and Production	22,667	18,450	3,000	-15,450	-83.7%
Reservoir Life Extension/Management	8,724	6,914	5,000	-1,914	-27.7%
Effective Environmental Protection	9,592	9,714	7,000	-2,714	-27.9%
Total, General Goal 4 (Petroleum – Oil Technology)	40,983	35,078	15,000	-20,078	-57.2%

Oil Technology

Funding Schedule by Activity

(dollars in thousands)

	FY PY	FY CY	FY BY	\$ Change	% Change
Oil Technology					
Exploration and Production.....	22,667	18,450	3,000	-15,450	-83.7%
Reservoir Life Extension/ Management.....	8,724	6,914	5,000	-1,914	-27.7%
Effective Environmental Protection.....	9,592	9,714	7,000	-2,714	-27.9%
Total, Oil Technology	40,983	35,078	15,000	-20,078	-57.2%

Detailed Justification

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Exploration and Production **22,667** **18,450** **3,000**

This program develops technologies that will address major market and technological barriers to increase domestic supply of oil at reasonable prices while protecting the environment. In FY 2005, the Exploration and Production program will be focused on Enhanced Oil Recovery (EOR) and CO₂ injection technologies and diversification of the global oil supply. The oil remaining after conventional production (377 billion barrels) cannot be recovered without the application of EOR technologies. Carbon dioxide flooding is a proven EOR technology that prolongs the life of some mature oilfields while contributing to long-term climate change goals. Bilateral technology exchange and joint research, in areas including EOR, CO₂ injection and unconventional oil resources, between the U.S. and non-OPEC countries will also increase oil supplies.

■ **EOR/CO₂ Injection** **0** **1,975** **1,980**

In FY 2005 the President's focus on Energy Security will be supported through both short and long term efforts to enhance utilization of industrial CO₂. The long term focus will continue studies related to EOR/CO₂ injection initiated in FY2004. The short term focus will include new programs to accelerate commercial adoption of CO₂-EOR based on use of industrial CO₂. The strategy used in this short-term focus will be to increase the adoption of "best practices" to opportunities existing in the near-term. Specifically, basin-wide strategies would be examined to identify ways to lower cost and accelerate infrastructure development to cost effectively deliver CO₂ from industrial sites to candidate oil fields; this effort includes resolving potential permitting

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

and regulatory issues.

The enhanced domestic supply resulting from these programs support the vision of ensuring a reliable and affordable supply of petroleum. The reliable supply aspect will be augmented by programs engaging in international relationships to support and enhance diversity of global oil supply. These programs will include such activities as technology transfer and conservation in priority countries/regions. *Participants include Northrop Grumman, 4th Wave Imaging, Paulsson Geophysical Services, Univ. Wyoming, Mass. Inst. Tech, TBD.*

In FY 2004, reservoirs will be identified based upon economics, technological issues, and feasibility for benefit from CO₂ injection. Technology to make CO₂ flooding applicable to a wider class of reservoirs will be pursued. Oil reservoirs will be mapped with locations of existing industrial sources and the price and/or incentives for CO₂ that would be needed to make the project economical. Flooding scenarios will be considered to leave maximum CO₂ in the reservoir. Program success will offer options for future carbon management policy choices. *Participants to be determined.*

There was no activity in FY 2003.

■ **Diversity of Global Oil Supply** 0 0 990

In FY 2005, diversification of international sources of oil supplies will be supported through bilateral activities with nations that are expanding their oil industry, including Venezuela, Canada, Russia, Mexico, and certain countries in West Africa. Bilateral and multi-lateral work will include technology exchanges and joint research, development and demonstration under the Administration's North American Initiative and other international agreements.

No funding was requested for this activity in FY 2004 and FY 2003.

■ **Advanced Drilling, Completion and Stimulation** 1,987 1,975 0

No funding is requested for this activity in FY 2005.

FY 2004 and FY 2003 funding continued upgrades to the Advanced Cuttings Transport Facility that allowed high-temperature/high-pressure experimentation on energized fluids (air, mist, gas assisted, foam, etc.) and synthetic drill fluids, cements, and transport of fluids in horizontal and inclined wellbores. *Participants included: PRRC, University of Tulsa, National Labs, NETL.*

■ **Advanced Diagnostics and Imaging Systems** 4,967 4,939 0

No funding is requested for this activity in FY 2005.

FY 2004 and FY 2003 funding continued development of advanced reservoir diagnostics and imaging systems to optimize oil discovery and recovery. Developed quantitative engineering parameters that control rock-fluid interactions which impact oil production. Continued fundamental geoscience efforts focusing on geoscience/engineering reservoir characterization on naturally fractured reservoirs. *Participants included: Cal Tech, National Labs, NAS, ERCH.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

■ **Multi-National Laboratory/Industry Partnership and National Laboratory Supporting Research**

1,987 1,975 0

No funding is requested for this activity in FY 2005.

FY 2004 and FY 2003 funding continued the transfer of technologies that advance understanding of the characteristics and producibility from oil reservoirs. *Participants included: National Labs*

■ **Reservoir Efficiency Processes**

5,100 4,940 0

No funding is requested for this activity in FY 2005.

FY 2004 and FY 2003 funding continued development of improved gas flooding recovery methods and advanced the state-of-the-art in reservoir simulation. *Participants included: NETL, TBD.*

■ **Analysis and Planning**

1,936 0 0

No funding is requested for this activity in FY 2005 and FY 2004. Appropriate planning and analysis activities will be undertaken in the relevant program areas.

FY 2003 funding continued technical planning and analysis support for implementing and evaluating effective and efficient oil technology research programs. Enhanced and maintained statistical data, models and supporting systems to evaluate petroleum policy options and to enhance metrics capabilities. Validated the effectiveness of the oil technologies to meet programmatic and agency goals. *Participants included: RMC, IOGCC, TRW.*

■ **Fundamental Research - PRIME**

4,967 0 0

No funding is requested for this activity in FY 2005 and FY 2004.

FY 2003 funding continued development of PRIME, pre-application research focused on the development of exploration and production technologies. General areas include remote sensing, geochemical survey and improved resolution of 3-component seismic, slimhole tools for logging and testing, remote wireless monitoring and control tools, and advanced petroleum recovery technologies. *Participants include Univ. of AL, Univ. of WY, TerraTek, Univ. of Tulsa, Univ. of So. Miss., Univ. of TX at Austin, Rice Univ., TX EES, Stanford.*

■ **Arctic Research**

1,491 1,481 0

No activity in FY 2005.

In FY 2004 and FY 2003, research will continue on the oxygen transport membrane being conducted at the University of Alaska, Fairbanks. Other research will be conducted in oil-related projects through the Office of Arctic Energy including tundra travel model for the North Slope of Alaska, characterization and alteration of wettability states of Alaskan reservoirs, and physical, biological and chemical implications of mid-winter pumping of tundra ponds. *Participants*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

included UAF, AK Dept. Natural Resources, TBD.

■ **Russia Technology Program**..... **0** **988** **0**

No funding is requested for this activity in FY 2005.

In FY 2004, the Russian Cooperative Research Program will include, but not be limited to, one or more of the following technology focus areas: USGS-Russian Offshore Arctic Resource Assessment; World Bank Global Gas Flaring Initiative; Arctic Construction and Operations Technology Transfer Initiative; “Full Value Chain” Oil Spill Restoration; Prevention, and Response Program; and/or, U.S.-Russia Commercial Energy Summit Education Initiative.

No funding was requested for this activity in FY 2003.

■ **Program Support**..... **232** **177** **30**

Fund technical and program management support.

Reservoir Life Extension/Management **8,724** **6,914** **5,000**

In FY 2005, the Reservoir Life Extension/Management program will focus on Domestic Resource Conservation (DRC) that will target partnerships with industry and academia to foster cost effective technologies and encourage best practices and approaches to conserve reservoir access to marginal well fields that make up 40% of our domestic production. The overall goal of DRC is to optimize Federal efforts to maintain U.S. domestic oil production capacity and enhance access to the remaining oil resource target.

In FY 2004, the Reservoir Life Extension/Management program was refocused on Domestic Resource Conservation which will target partnerships with industry and academia to foster cost effective technologies and encourage best practices and approaches to conserve reservoir access to marginal well fields that make up 40% of our domestic production. The goal is to optimize Federal efforts to maintain U.S. domestic oil production capacity and enhance access to the remaining oil resource target.

In previous years, Reservoir Life Extension/Management focused on shorter-term research with public benefits and a much more defined return on investment. Given the industry’s incentive to continue this type of research on its own, Federal funding was redirected to longer-term, higher risk efforts that can help preserve U.S. academic and technological leadership in this area.

■ **Domestic Resource Conservation** **8,635** **6,844** **4,950**

In FY 2005, elements include: 1) Key technology prototype development, such as micro-hole technologies, for enabling improved access and minimizing environmental impact; 2) Technology transfer with special emphasis on independents; and 3) Policy analysis and planning to prioritize program efforts and provide policy evaluations to maximize impact on domestic oil recovery over a wide range of technological and economic conditions. *Participants include PTTC, Northrop Grumman, NETL and TBD.*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

In FY 2004, elements include: 1) Key technology prototype development, such as micro-hole technologies, for enabling improved access and minimizing environmental impact; 2) Technology transfer with special emphasis on independents; and, 3) Policy analysis and planning to prioritize program efforts and provide policy evaluations to maximize impact on domestic oil recovery over a wide range of technological and economical conditions. *Participants to be determined.*

In FY 2003, the following activities were conducted: selected competitive projects that partner with independents to accelerate field testing and use of effective technologies; addressed critically underdeveloped resources owned and managed by Native American Tribes and Corporations; disseminated petroleum RD&D results to domestic stakeholders; developed mechanisms that foster communication between industry and researchers; continued to expedite the use of cost effective, more efficient, environmental friendly technologies that increase recovery; continued support of Minority Education Initiative; continued to provide other energy related educational opportunities; populated the Internet-accessible database of "best practices" resulting from the PUMP projects and conferences; and issued solicitation for "PUMP" projects to address short-term demonstrations of critical technologies in specific regions. *Participants included: INEEL, Penn State, HQ, APTA, CEED, COMET, GWPC, U. of Ok, PTTC, RMC, NETL, other National Labs, TBD.*

■ Program Support	89	70	50
--------------------------------	-----------	-----------	-----------

Fund technical and program management support.

Effective Environmental Protection	9,592	9,714	7,000
---	--------------	--------------	--------------

The Effective Environmental Protection program will continue to focus on technologies and practices that reduce the environmental impact of oil exploration, production, and processing while minimizing the cost of effective environmental protection and compliance. The program supports energy security by helping to overcome the environmental barriers that limit access to domestic resources. The program also supports the President's Clear Skies Initiative by reducing emissions from oil production and processing. The program supports the recommendations of the National Energy Policy by encouraging additional recovery from existing wells, providing science and technology to allow additional oil development on Federal lands and providing answers to environmental questions that are limiting oil exploration and production in the National Petroleum Reserve - Alaska. Activities will provide a complete examination of specific impact of produced water and the more general problem of water management. A detailed roadmap of the necessary actions will be presented in a public workshop for discussion and inclusion of stakeholder views. The overall objective is to help balance the need to develop the Nation's energy resources while maintaining our environmental values. This program fills critical information and technical gaps that are needed to meet the Nation's energy needs without sacrificing environmental quality.

■ Environmental Science	0	9,618	6,930
--------------------------------	----------	--------------	--------------

In FY 2005, conduct targeted activities to define and solve specific problems in key areas,

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

specifically: 1) management of produced water and technology development that makes produced water a resource for beneficial uses; and 2) ensuring maximum sustainable access to oil resources on Federal lands. A public education and outreach program will be conducted to ensure that accurate information about the impacts of oil development is presented to the public. Develop objective, credible scientific data for regulatory decisions as part of a program-wide environmental strategy for maintaining U.S. oil production capacity. *Participants include: KS State Univ, Northrop Grumman, TX -EES, Univ of N Carolina, Univ of TX at Austin, NETL, LBNL, LLNL TBD.*

In FY 2004, conduct targeted activities to define and solve specific problems in key focus areas, specifically: 1) management of produced water and technology development that makes produced water a resource for beneficial uses; and, 2) ensuring maximum sustainable access to oil and gas resources on Federal lands. An outreach program will be conducted to ensure that accurate information about the impacts of oil and gas development is presented to the public. Develop objective, credible scientific data for regulatory decisions as part of a program-wide environmental strategy for maintaining U.S. oil production capacity. *Participants include: NETL, National Labs, BLM, TBD*

FY 2003 funding was included in the activities below.

■ Program Planning and Data Analysis	880	0	0
---	------------	----------	----------

In FY 2005 and FY 2004, activity combined in Environmental Science activity above.

FY 2003 funding continued analysis of industry environmental trends and available technologies. Maintained performance measurement data for program planning and technology transfer. Provided energy and economic analyses for legislative and regulatory initiatives related to oil environmental issues. Provided analysis of refinery related environmental issues and regulations. *Participants included: PERF, National Labs, EPA*

■ Streamline State/Tribal/Federal Regulations	2,687	0	0
--	--------------	----------	----------

In FY 2005 and FY 2004, activity combined in Environmental Science activity above

FY 2003 funding continued development, in cooperation with Federal and State agencies, of streamlined environmental regulations and regulatory processes with emphasis on reducing permitting times for refinery upgrades and domestic production from public lands, while maintaining environmental protection. The objective of this key activity was to increase domestic production and refinery capacity by reducing the cost of compliance. *Participants included: ORNL and other National Labs, University of Tulsa, IOGCC.*

■ Risk Assessment.....	1,953	0	0
-------------------------------	--------------	----------	----------

In FY 2005 and FY 2004, activity combined in Environmental Science activity above.

FY 2003 funding continued development of credible scientific data for regulatory decision making in all aspects of exploration, production, and processing. *Participants included: National*

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Laboratories, BLM, PERF, GWPC

■ **Technology Development**..... 3,974 0 0

In FY 2005 and FY 2004, activity combined in Environmental Science activity above.

FY 2003 funding continued development of technologies to reduce produced water handling costs and explored innovative refinery technologies that could significantly reduce CO₂ emissions.

Participants included: NETL and other National Laboratories, University of Tulsa, GEER.

■ **Program Support**..... 98 96 70

Fund technical and program management support.

Total, Petroleum - Oil Technology 40,983 35,078 15,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Exploration and Production

■ Decreases consist of termination of work in Advanced Drilling, Completion and Stimulation, Advanced Diagnostics and Imaging Systems, Partnership Program, Advanced Technologies for High Risk Resources; and Arctic Research. Planning and Analysis is reduced because the program is being realigned to specifically support the President's climate change and energy security goals -15,450

Reservoir Life Extension

■ Decreases consist of termination of work in Technology Development with independents, Native American program, Field Demonstrations, and PUMP. Outreach and Technology Transfer is reduced because the program is being realigned to specifically support the President' climate change and energy security goals -1,914

Effective Environmental Protection

■ Decreases consist of termination of research on lower priority environmental issues, such as remediation, NORM, air emissions, and work the conducted by the Natural Gas and Oil Technology Partnership -2,714

Total Funding Change, Petroleum - Oil Technology -20,078

Program Direction and Management Support

Funding Profile by Category

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	% Change	% Change
Headquarters					
Fossil Energy Research and Development					
Salaries and Benefits.....	12,131	15,043	15,200	+157	+1.0%
Travel	536	530	623	+93	+17.5%
Support Services	6,110	6,616	6,926	+310	+4.7%
Total, Fossil Energy Research and Development	18,777	22,189	22,749	+560	+2.5%
Clean Coal Technology					
Salaries and Benefits.....	0	2,717	2,750	+33	+1.2%
Travel	0	183	185	+2	+1.1%
Support Services	0	1,940	1,465	-475	-24.5%
Total, Clean Coal Technology	0	4,840	4,400	-440	-9.1%
Headquarters Program Direction					
Salaries and Benefits.....	12,131	17,760	17,950	+200	+1.1%
Travel	536	713	808	+95	+13.3%
Support Services	6,110	8,556	8,391	-165	-1.9%
Total, Headquarters	18,777	27,029	27,149	+120	+0.4%
Full Time Equivalents.....	110	127	127	0	+0.0%
National Energy Technology Laboratory					
Fossil Energy Research and Development					
Salaries and Benefits.....	34,211	37,002	37,756	+754	-2.0%
Travel	1,515	1,432	1,495	+63	+4.4%
Support Services	32,726	30,787	30,000	-787	-2.6%
Total, Fossil Energy Research and Development	68,452	69,221	69,251	+30	+0.04%
Clean Coal Technology					
Salaries and Benefits.....	0	6,543	6,625	+82	+1.2%
Travel	0	118	120	+2	+1.7%
Support Services	0	3,314	2,855	-459	-13.9%
Total, Clean Coal Technology	0	9,975	9,600	-375	-3.8%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	% Change	% Change
National Energy Technology Laboratory					
Salaries and Benefits.....	34,211	43,545	44,381	+836	+1.9%
Travel	1,515	1,550	1,615	+65	+4.2%
Support Services	32,726	34,101	32,855	-1,246	-3.7%
Total, National Energy Technology Laboratory	68,452	79,196	78,851	-345	-0.4%
Full Time Equivalents.....	348	397	397	0	0.0%
Total Program Direction					
Headquarters Fossil Energy Research and Development					
Salaries and Benefits.....	12,131	15,043	15,200	+157	+1.0%
Travel	536	530	623	+93	+17.5%
Support Services	6,110	6,616	6,926	+310	+4.7%
Total, Headquarters Fossil Energy Research and Development	18,777	22,189	22,749	+560	+2.5%
National Energy Technology Laboratory Fossil Energy Research and Development					
Salaries and Benefits.....	34,211	37,002	37,756	+754	-2.0%
Travel	1,515	1,432	1,495	+63	+4.4%
Support Services	32,726	30,787	30,000	-787	-2.6%
Total, National Energy Technology Laboratory Fossil Energy Research and Development	68,452	69,221	69,251	+30	+0.04%
Clean Coal Technology					
Salaries and Benefits.....	0	9,260	9,375	+115	+1.2%
Travel	0	301	305	+4	+1.3%
Support Services	0	5,254	4,320	-934	-17.8%
Total, Clean Coal Technology	0	14,815	14,000	-815	-5.5%
Total, Program Direction					
Salaries and Benefits.....	46,342	61,305	62,331	+1,026	+1.7%
Travel	2,051	2,263	2,423	+160	+7.1%
Support Services	38,836	42,657	41,246	-1,411	-3.3%
Total, Program Direction.....	87,229	106,225	106,000	-225	-0.2%
Total Full Time Equivalents.....	458	524	524	524	524

Mission

Program Direction and Management Support provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Fossil Energy Research and Development program.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. Fossil Energy performs critical functions which directly support the mission of the Department. Headquarters staff provide functions including overall direction of the programs that includes implementing DOE policy, communicating guidance consistent with that policy to the FE field offices, establishing program objectives, developing program plans and evaluating alternative program strategies, developing and defending budget requests to the Office of Management and Budget and to Congress, reviewing procurement plans, monitoring work progress, and approving revisions in work plans as required to attain program goals. The NETL performs the day-to-day project management functions of assigned programmatic areas that include monitoring Fossil Energy contracts and National Laboratory activities, developing project budgets, implementing procurement plans, and other program and site support activities necessary to achieve program objectives.

In FY 2004 and FY 2005, all program direction and management support costs associated with the Clean Coal Technology program have been combined with those of Fossil Energy Research and Development under this account.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Headquarters	18,777	27,029	27,149
Salaries and Benefits	12,131	17,760	17,950

In FY 2005, provide funds for 127 FTE=s (includes 17 FTE=s transferred from the CCT account) at Headquarters. This staff implements and communicates policy to the NETL=s and other field offices, sets program objectives, develops program plans and evaluates alternative strategies; develops and defends budget requests; approves procurement plans; and monitors work progress.

FY 2004 funds provided for 127 FTE=s (includes 17 FTE=s transferred from the CCT account) at Headquarters. FY 2003 funding provided funds for 110 FTE=s (Fossil Energy R&D only) at Headquarters. Salaries and benefits for the CCT staff were provided under the CCT account in FY 2003. This staff implements and communicates policy to the NETL=s and other field offices, sets program objectives, develops program plans and evaluates alternative strategies; develops and defends budget requests; approves procurement plans; and monitors work progress.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

Travel..... 536 713 808

In FY 2005, provide funds for travel in support of the activities stated above. Both domestic and international travel are conducted.

FY 2004 funding provided for travel in support of the activities stated above. FY 2003 funding provided for Fossil Energy R&D Headquarters staff only; at that time Clean Coal Technology travel was funded under the CCT account. Both domestic and international travel was conducted.

Support Services 6,110 8,556 8,391

▪ **Technical and Management Support Services..... 1,838 4,113 3,465**

In FY 2005, provide for contractual services that are generic to the entire FE program. Included are items such as computer services, technical and management support services.

FY 2004 funding provided for contractual services that are generic to the entire FE program. FY 2003 funding provided for Fossil Energy R&D Headquarters contract services only, at that time Clean Coal Technology contract services were funded under the CCT account. Included are items such as computer services, technical and management support services.

▪ **Computer Systems and Support..... 795 988 1,026**

The Headquarters information technology investment includes costs associated with general information technology infrastructure support including LAN, internet and intranet networking, cyber security, desktop support, tele-video, information architecture planning and systems support.

▪ **Working Capital Fund 3,477 3,455 3,900**

In FY 2005, provides funding for the Departments working capital fund.

In FY 2004 and FY 2003, provided funding for the Department=s working capital fund.

▪ **Small Business and Innovative Research (SBIR)..... 0 0 0**

In FY 2005, fund SBIR in the amount of \$11,873,000 from prior year and/or various R&D program funds within the Fossil Energy R&D account.

In FY 2004, funded SBIR in the amount of \$12,137,000 from prior year and/or various R&D program funds within the Fossil Energy R&D account.

FY 2003 funded SBIR in the amount of \$11,444,000 using prior year and/or various R&D program funds with the Fossil Energy R&D account.

▪ **Small Business Technology Transfer (STTR) 0 0 0**

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

In FY 2005, fund STTR in the amount of \$699,000 from prior year and/or various R&D program funds within the Fossil Energy R&D account.

In FY 2004, fund STTR in the amount of \$702,000 from prior year and/or various R&D program funds within the Fossil Energy R&D account.

FY 2003 funded STTR in the amount of \$695,000 using prior year and/or various R&D program funds with the Fossil Energy R&D account.

National Energy Technology Laboratory	68,452	79,196	78,851
Salaries and Benefits	34,211	43,545	44,381

In FY 2005, provide funds for NETL staff of 397 FTEs (includes 49 FTE=s transferred from the CCT account). Activities of the staff include project management, product development, contract management, and other service activities related to program and site support. It is anticipated that 20 FTEs of the 397 FTEs will be paid via reimbursable agreements, therefore, salaries and benefits associated with these FTEs are not included in the budget estimate

In FY 2004, provided funds for NETL staff of 397 FTEs (includes 49 FTE=s transferred from the CCT account). Activities of the staff include project management, product development, contract management, and other service activities related to program and site support. Of the 397 FTEs, 20 FTEs were paid via reimbursable agreements, therefore, salaries and benefits associated with these FTEs are not included in the budget estimate.

FY 2003 funding provided for NETL staff of 348 FTEs (does not include 49 FTE=s funded in CCT account) . Activities of the staff include project management, product development, contract management, and other service activities related to program and site support. Nine of the FTEs in FY 2003 were paid via reimbursable agreements, therefore, salaries and benefits associated with these FTEs are not included in the budget estimate.

Travel.....	1,515	1,550	1,615
--------------------	--------------	--------------	--------------

In FY 2005, provide funds for travel in support of the above activities in the attainment of program goals, both on the domestic front and abroad.

In FY 2004, provide funds for travel in support of the above activities in the attainment of program goals, both on the domestic front and abroad.

FY 2003 funding provided for travel in support of the activities stated above; at that time Clean Coal Technology travel was funded under the CCT account. Both domestic and international travel was conducted.

Support Services	32,726	34,101	32,855
-------------------------------	---------------	---------------	---------------

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

The NETL information technology investment is funded in this budget line. This investment includes costs associated with general information technology infrastructure support including LAN, internet and intranet networking, cyber security, desktop support, televideo, telecom, information architecture planning and systems support. Additionally, this investment covers specific mission related systems support including the TORIS and PROMIS systems.

In FY 2005, provide funding for facility operations, maintenance, finance, information automation, administrative, management and technical support.

In FY 2004, provide funding for facility operations, maintenance, finance, information automation, administrative, management and technical support.

FY 2003 funding provided for facility operations, maintenance, finance, information automation, administrative, management and technical support. In FY 2003, those activities related to the Clean Coal Technology program were funded under the CCT account.

Total, Program Direction and Management Support	87,229	106,225	106,000
--	---------------	----------------	----------------

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Headquarters

▪ Mandatory pay increase.....	+190
▪ Increase in Travel	+95
▪ Increase in Contract Services	-165

National Energy Technology Laboratory

▪ Mandatory pay increase.....	+836
▪ Increase in Travel	+65
▪ Increase in Contract Services	-1,246

Total Funding Change, Program Direction	-225
--	-------------

Plant and Capital Equipment

Funding Profile by Subprogram

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	% Change	% Change
Construction.....	6,954	6,914	0	-6,914	-100.0%
Total, Plant and Capital Equipment	6,954	6,914	0	-6,914	-100.0%

Mission

The mission of the Plant and Capital Equipment program is to maintain the facilities necessary to safely and effectively carryout the mission of the Fossil Energy R&D program.

Benefits

General plant projects include repairs, improvements, alteration and additions that are essential to the safe, environmentally acceptable and efficient operations of NETL sites and ARC.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
■ GPP at NETL and ARC	2,980	2,963	0
Provides no funding in FY 2005 for General Plant Projects (GPP) at the National Energy Technology Laboratory and the Albany Research Center.			
■ NETL Office/Lab Building	3,974	3,951	0
Provides no funding in FY 2005 for the fourth year of the National Energy Technology Laboratory's seven-year facilities and infrastructure renovation project.			
FY 2004 and FY 2003 funding provided for building design for facilities at both the Pittsburgh and Morgantown sites; renovation of several buildings; demolition of several buildings and subsequent site preparation; expand parking facilities; and enhanced security measures.			
Total, Plant and Capital Equipment	6,954	6,914	0

Explanation of Funding Changes

FY 2005 vs FY 2004 (\$000)

The FY 2005 request includes no funding for GPP and the fourth year of the National Energy Technology Laboratory's seven-year facilities and infrastructure renovation project.

-6,914

Total Funding Change, Plant and Capital Equipment

-6,914

Fossil Energy Environmental Restoration

Funding Schedule by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Fossil Energy Environmental Restoration	9,652	9,595	9,595	6,000	-3,595	-37.5%
Total, Fossil Energy Environmental Restoration	9,652	9,595	9,595	6,000	-3,595	-37.5%

Mission

The objectives of the Fossil Energy (FE) Environmental Restoration activities are to ensure protection of workers, the public, and the environment in performing the mission of the National Energy Technology Laboratory (NETL) at the Morgantown (MGN), West Virginia, Pittsburgh (PGH), Pennsylvania, and Tulsa, Oklahoma sites, and the Albany Research Center (ARC) at Albany, Oregon.

Benefits

Environment, Safety and Health activities include those necessary to protect workers and the public from exposure to hazardous conditions and materials (e.g., fires, carcinogens, asbestos, lead, etc.), identify and correct safety and health hazards, improve workplace monitoring and industrial safety programs, achieve compliance with Federal, state and local environment, safety, and health requirements, including Department of Energy (DOE) initiatives, and implement initiatives related to achieving best-in-class performance. Activities also include environmental protection, and cleanup activities on-site, and at several former off-site research and development locations. Groundwater and soil monitoring/remediation is also required at the NETL and ARC sites to ensure compliance with Federal, state and local requirements.

FY 2005 performance measures are listed below that support the overarching goal of making consistent and measurable progress in reducing and eliminating injuries, incidents and environmental releases.

- Maintain risk management programs and Federal permit compliance status at NETL.
- Conduct remediation activities at Rock Springs and Hoe Creek, WY sites.
- Conduct environmental monitoring and surveillance activities (air, water, wastewater) in support of permit maintenance.
- Conduct ES&H training according to job hazard analyses.
- Conduct a series of lead and asbestos abatement actions and remove hazardous materials at ARC.
- Maintain emergency response and security program capabilities at ARC.

- Continue with equipment/facility upgrades and infrastructure repairs, including facility evaluations at ARC.
- Complete lead and asbestos abatement actions at NETL as required by maintenance, construction, and projects.
- Conduct groundwater monitoring and remediation activities at ARC.
- Implement limited activities to meet waste minimization and energy efficiency goals.
- Implement continuity of operations program at NETL.
- Maintain programs for purchasing environmentally preferable products and services.
- Reduce sanitary waste from routine operations at ARC.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
CERCLA Remedial Actions.....	1,987	1,843	1,250
■ Rock Springs Sites	795	592	592
<p>In FY 2005, operate and maintain the <i>In-Situ</i> Aeration Bioremediation Systems at Rock Spring Sites to remove BTEX compounds from Tipton aquifer ground water, as required by the WDEQ. Conduct periodic ground water sampling events to determine progress in removing contaminants from the Tipton aquifer. <i>Participants include: Army Corps of Engineers.</i></p> <p>In FY 2004, continue second year of full-scale cleanup of Rock Springs sites (~7 year program). <i>Participants include: Army Corps of Engineers.</i></p> <p>FY 2003 funding continued cleanup of the Rock Springs sites, with full-scale cleanup beginning in FY 2003. <i>Participants included: Army Corps of Engineers.</i></p>			
■ Hoe Creek Site	298	306	306
<p>FY 2005, seal and abandon all wells, except long-term monitoring wells to be used in contaminant rebound evaluations, as required by the WDEQ. <i>Participants include: Army Corps of Engineers.</i></p> <p>In FY 2004, continue third year of full-scale cleanup of Hoe Creek site (~7 year program). <i>Participants include: Army Corps of Engineers.</i></p> <p>FY 2003 funding continued full-scale cleanup of the Hoe Creek site. <i>Participants included: Army Corps of Engineers.</i></p>			
■ Hannah Site Revegetation.....	70	25	25
<p>In FY 2005, closeout active operations with respect to revegetation initiatives.</p> <p>In FY 2004, continue Hannah Site revegetation (~10 year program).</p> <p>FY 2003 funding continued Hannah Site revegetation.</p>			

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

■ **NETL Preliminary Site Investigations** **298** **439** **77**

In FY 2005, initiate the discovery and investigation of one former FE Research and Development (R&D) site. Conduct preliminary assessments (PA) if necessary to determine environmental risk prior to contract closeout.

In FY 2004 implement three additional off-site investigations and remediations related to project closeouts, based on results of risk analyses.

FY 2003 funding continued implementation of ne CERCLA site investigations and project closeouts.

■ **NETL Site Remediation** **30** **30** **0**

In FY 2005, no funding is requested for this activity.

In FY 2004 perform on-site building and soil type remediation assessments at NETL (re-assessment).

FY 2003 funding provided for on-site CERCLA-type remediation assessments at NETL.

■ **CERCLA PRP Response Activities** **496** **451** **250**

In FY 2005, conduct remedial investigations and feasibility studies on sites found to be contaminated and requiring cleanup under Federal CERCLA and State cleanup standards.

In FY 2004, implement CERCLA PRP Response Activities.

FY 2003 funding continued implementation of CERCLA PRP Response Activities.

RCRA Remedial Actions **2,285** **2,039** **1,758**

■ **NETL On-Site Remediation** **1,540** **1,398** **1,208**

In FY 2005, continue NETL on-site regulatory and corrective, activities such as: lead and asbestos abatement; waste minimization and pollution prevention activities including managing residual wastes; achieving/maintaining compliant wastewater treatment plant operations, and site support contractor RCRA-related maintenance activities.

In FY 2004, continue NETL on-site corrective, preventive, and improvement activities such as; lead and asbestos abatement; upgrading chemical handling facilities; waste minimization and pollution prevention activities including managing residual wastes; environmental management plan implementation required for maintenance of ISO 14001 certifications; surface water compliance; and site support contractor RCRA related maintenance activities.

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

FY 2003 funding continued NETL on-site corrective, preventive, and improvement activities such as; lead and asbestos abatement; hazardous material and waste compliance; waste minimization and pollution prevention activities including managing residual wastes; environmental management plan implementation required for maintenance of ISO 14001 certifications; surface water compliance; and site support contractor RCRA related maintenance activities.

■ **Albany Research Center RCRA** **745** **641** **550**

In FY 2005, continue ARC RCRA cleanup actions including abating lead and asbestos exposures; resolving chemical storage and labeling; monitoring soil and groundwater; upgrading ventilation and air pollution systems; and improving air emission management, materials handling, and waste disposal activities.

In FY 2004, continue ARC RCRA cleanup actions including abating lead and asbestos exposures; resolving chemical storage and labeling issues; monitoring soil and groundwater; upgrading ventilation and air pollution control system; implementing environmental management system plan required for ISO 14001 certification; and improving air emission management, materials handling, and waste disposal activities.

FY 2003 funding continued ARC RCRA cleanup actions including abating lead and asbestos exposures; characterizing and resolving chemical storage and labeling; monitoring soil and groundwater; upgrading ventilation and air pollution control system; and improving air emission management, materials handling, and waste disposal activities.

Other ES&H Actions **5,380** **5,713** **2,992**

■ **Other ES&H Actions at NETL** **4,282** **4,494** **2,224**

In FY 2005, implement baseline regulatory and Integrated Safety Management/ISO 14001 programs (emergency management, occupational medicine and health, safety, environmental management, ergonomics, training, and fire protection) at NETL. Implement limited actions in support of achieving DOE's pollution prevention and energy management goals.

In FY 2004, maintain regulatory and Integrated Safety Management/ISO 14001 programs (emergency management, occupational medicine and health, safety, environmental management, ergonomics, training, and fire protection) at NETL. Identify safety improvements required to achieve external OSHA-type certifications. Identify and implement safety-related security improvements. Continue to execute environmental objectives and targets under NETL's ISO 14001 programs, including incremental and continued achievement of DOE's pollution prevention and energy leadership goals. Conduct highest priority indoor and CFC-related air quality fixes.

FY 2003 funding maintained regulatory and Integrated Safety Management/ISO 14001 programs (emergency management, occupational medicine and health, safety, environmental management, ergonomics, training, and fire protection) at NETL. . Continued to execute environmental objectives and targets under NETL's ISO 14001 programs, including incremental and continued

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

achievement of DOE's pollution prevention and energy leadership goals. Conducted highest priority indoor and CFC-related air quality fixes.

■ **ES&H Corrective Action at NETL Tulsa Site** 15 25 10

In FY 2005, perform ES&H-related training and an ergonomics review to determine personnel at risk of ergonomic injury. Perform testing of and maintenance on fixed fire protection systems. Conduct emergency management drills.

In FY 2004, continue ES&H program activities at NPTO including inspections, emergency management and drills, training, etc. Expand environmental management system to Tulsa site.

FY 2003 funding continued ES&H program activities at NETL Tulsa site including inspections, emergency management and drills, training, etc.

■ **ES&H Corrective Action at ARC** 984 1,098 698

In FY 2005, continue ARC safety and health programs and corrective actions including monitoring and surveillance, emergency preparedness and drills, and security improvements. Maintain indoor air quality and ventilation systems, walking surfaces, personal protective equipment maintenance, facility seismic evaluations, and training. Continue incremental progress toward DOE's pollution prevention and energy management goals. Costs also include contracted security, ISM, and ISO 14001 support.

In FY 2004, continue ARC safety and health programs and corrective actions including monitoring and surveillance; emergency preparedness and drills; and security improvements. Upgrade indoor air quality and ventilation systems; medical and industrial hygiene services; fire detection and suppression systems; walking surfaces; personal protective equipment maintenance; facility seismic evaluations; and training. Continue to execute revised environmental objectives and targets under ARC's ISO 14001 programs, including incremental and continued achievement of DOE's pollution prevention and energy leadership goals. Costs also include contracted security, ISM, and ISO 14001 support.

FY 2003 funding continued ARC safety and health programs and corrective actions including monitoring and surveillance; emergency preparedness and drills; security improvements; and contracted security support. Upgrade indoor air quality and ventilation systems; medical and industrial hygiene services; fire detection and suppression systems; walking surfaces; personal protective equipment maintenance; and training.

■ **Program Support** 99 96 60

Fund technical and program management support.

Total, Fossil Energy Environmental Restoration	9,652	9,595	6,000
---	--------------	--------------	--------------

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

<ul style="list-style-type: none"> ■ Decrease in CERCLA Remedial Actions will defer actions including the conduct of remedial investigations and feasibility studies and Treatability studies on sites found to be contaminated and requiring cleanup under CERCLA and State Standards; risk assessments of on-site inactive waste sites; and on-site sampling and analysis to determine the need for site cleanup 	-593
<ul style="list-style-type: none"> ■ Decrease in RCRA funding will defer actions including the decontamination/ decommissioning of selected NETL-PGH R&D buildings; upgrading chemical handling and dispensing facilities and environmental management plan implementation required for maintenance of ISO 14001 certification at NETL and ARC 	-281
<ul style="list-style-type: none"> ■ Decrease in Other ES&H funding will defer actions including the monitoring and cleanup of environmental contamination at ARC; the upgrade of gas alarm systems in NETL buildings; execution of environmental plans, objective and targets under NETL's and ARC's ISO 4001 programs; identification and implementation of safety-related security and infrastructure improvements; conduct of high priority air quality fixes including CFC-elimination and ventilation improvement activities; enhancement of energy management program including metering of individual facilities/projects for energy use; indoor air quality/ventilation fixes at NETL R&D buildings; implementation emergency power systems for NETL's ES&H critical operations; and the retrofit of chillers greater than 150 tons of cooling capacity manufactured before 1984 using Class I refrigerants..... 	-2,721
Total Funding Change, Fossil Energy Environmental Restoration	-3,595

Import/Export Authorization

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Import/Export Authorization	2,981	2,716	2,716	1,799	-917	-33.7%
Total, Import/Export Authorization	2,981	2,716	2,716	1,799	-917	-33.7%

Mission

The Office of Import/Export Authorization (OIEA) manages the regulatory review of natural gas imports and exports. In addition, the program exercises regulatory oversight of the conversion of existing oil and gas-fired powerplants, processes exemptions from the statutory provisions of the Powerplant and Industrial Fuel Use Act of 1978 (FUA), as amended, and processes certifications of alternate fuel capability pursuant to the provisions of the amended FUA.

Benefits

These regulatory activities help promote the national energy strategy goal of securing future energy supplies by helping to ensure: the availability of reliable, competitively priced natural gas; and that surplus domestic gas supplies can be marketed internationally in a competitive and environmentally sound manner.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Import/Export Authorization	2,981	2,716	1,799
■ Import/Export Authorization.....	2,683	2,445	1,619

In FY 2005, modify or rescind 3 conversion orders. Process 50 certifications of coal capability and 3 exemptions. Process 226 gas import/export applications. Provide support for consultations with U.S. trading partners. Provide regulatory compliance and industry monitoring. Provide petroleum policy support for ASFE. The electricity regulatory functions of this program have been transferred to the Office of Electricity Transmission and Distribution.

In FY 2004, modify or rescind 3 conversion orders. Process 50 certifications of coal capability and

(dollars in thousands)

FY 2003	FY 2004	FY 2005
---------	---------	---------

3 exemptions. Process 220 gas import/export applications. Provide support for consultations with U.S. trading partners. Provide regulatory compliance and industry monitoring. Provide petroleum policy support for ASFE. Process 103 electricity export applications and 11 construction permits. Monitor and analyze international and domestic electricity trade. Participate in FERC proceedings, international studies, and trade negotiations. Perform NEPA compliance activities.

FY 2003 funding provided for activities to modify or rescind 3 conversion orders. Process 50 certifications of coal capability and 3 exemptions. Process 200 gas import/export applications. Provide support for consultations with U.S. trading partners. Provide regulatory compliance and industry monitoring. Provide petroleum policy support for ASFE. Process 100 electricity export applications and 10 construction permits. Monitor and analyze international and domestic electricity trade. Participate in FERC proceedings, international studies, and trade negotiations. Perform NEPA compliance activities.

■ Program Support	298	271	180
Fund technical and program management support.			
Total, Import/Export Authorization	2,981	2,716	1,799

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

■ Decrease in Import/Export Authorization due to an transfer of the electricity regulatory function to the Office of Electricity Transmission and Distribution	-917
Total Funding Change, Import/Export Authorization	-917

Advanced Metallurgical Research

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Advanced Metallurgical Research	5,961	9,876	9,876	8,000	-1,876	-19.0%
Total, Advanced Metallurgical Research	5,961	9,876	9,876	8,000	-1,876	-19.0%

Mission

The Advanced Metallurgical Processes program conducts inquiries, technological investigations, and research concerning the extraction, processing, use, and disposal of mineral substances under the mineral and materials science program at the Albany Research Center (ARC) in Oregon.

Projects are focused on areas where there are large potential public benefits, but where industry would not invest on its own. The program addresses the full life cycle of materials production and cost-effective processing of improved materials through to their disposal and recycling. For example, the program seeks to determine the factors that limit service life of materials in industrial, structural, or engineering applications and to provide solutions to service-life problems through new materials technology. This is an area where the benefits to any single firm may be too low to attract investment, but will sum to large economic improvements if applied throughout the economy.

Another focus is to develop and demonstrate technologies that will create public benefits by reducing waste and pollution. For example, for the last four years the Program has sought ways to sequester CO₂, a greenhouse gas, by converting it to a stable mineral form; such a process, if proved practical and economic, could contribute to Fossil Energy's goal of a zero emission power plant. Thus, the research at ARC directly contributes to Fossil Energy's objectives by providing information on the performance characteristics of materials being specified for the current generation of power systems, on the development of cost-effective materials for inclusion in Vision 21 systems, and for solving environmental emission problems related to fossil fired energy systems. The program at ARC stresses full participation with industry through partnerships and emphasizes cost sharing to the fullest extent possible.

Benefits

The Advanced Metallurgical Program creates public benefits by carrying out long-term, high-risk research on materials that are key to the energy industry. Another focus is to create public benefits through the development of technologies that reduce waste and pollution.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Advanced Metallurgical Research	5,961	9,876	8,000
■ Advanced Metallurgical Processes.....	5,901	9,777	7,920
<p>In FY 2005, continue research to contribute to Fossil Energy's Vision 21 Systems by extending component service lifetimes through the improvement and protection of current materials, by the design of new materials, and by defining the service operating conditions for new materials in order to ensure their safe and effective use. Emphasis is placed on high-temperature erosion testing and modeling in environments anticipated for Vision 21 concepts, on the development of sulfidation/oxidation resistant materials, and development and repair of refractory materials, for coal gasifiers. The Albany Research Center will participate in an effort to develop, fabricate and evaluate the performance of materials to be used in solid oxide fuel cell applications. These could include metallic interconnects, seals, heat exchanger materials and reformer materials to support the Solid State Energy Conversion Alliance's (SECA's) goal of significantly reducing the cost of producing commercial, environmentally friendly solid oxide fuel cells. Continue research focused on developing an economically and environmentally acceptable integrated process for disposal of carbon dioxide. Redirect emphasis to application of mineral carbonation reactions to address leakage/sealing issues in geological sequestration approaches. <i>Participants include: ARC.</i></p> <p>FY 2004 funding continued development of advanced refractories for IGCC applications, CO₂ sequestration via mineral carbonation, advanced austenitic steels, and microchannel reactors for reformer and heat exchanger applications. In addition, efforts to support materials development for solid oxide fuel cell applications were initiated. <i>Participants included: ARC</i></p>			
■ Program Support.....	60	99	80
<p>In FY 2004, fund technical and program management support.</p>			
Total, Advanced Metallurgical Research	5,961	9,876	8,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

Advanced Metallurgical Research

• Redirect and reduce sequestration research related to mineral carbonation approaches. Eliminate funding for oxidation/sulfidation resistant materials development. Reduce funding levels for ultra-super critical steam turbine materials development. General reduction in research directed at fundamentals of materials performance in high temperature Fossil Energy applications	-1,857
• Program direction	-19
Total Funding Change, Advanced Metallurgical Research	-1,876

National Academy of Sciences Program Review

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
National Academy of Sciences Program Review	497	494	494	0	-494	-100.0%
Total, National Academy of Sciences Program Review	497	494	494	0	-494	-100.0%

Mission

This program provides for a study by the National Research Council (NRC) of prospective future benefits of Fossil Energy R&D. In FY 2003 and FY 2004, funding was appropriated to the Department's Office of Energy Efficiency and Renewable Energy (EERE), which will be combined with Fossil Energy (FE) funding for the NRC study. The study will focus on methodology and case studies. Past attempts at measuring future R&D benefits have been criticized on a variety of grounds, and the NRC study will need to address these criticisms. Once a methodology has been developed, a subset of FE and EERE technologies will be selected to test and showcase the methodology.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
National Academy of Sciences Program Review	497	494	0
■ National Academy of Sciences Program Review	497	494	0
No funding is requested for this activity in FY 2005.			
In FY 2004 and FY 2003, a study by the National Research Council (NRC) of prospective future benefits of Fossil Energy R&D was conducted.			
Total, National Academy of Sciences Program Review	497	494	0

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

National Academy of Sciences Program Review

• The study conducted by the National Research Council will be completed.....	-494
Total Funding Change, National Academy of Sciences Program Review.....	-494

Cooperative Research and Development

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Cooperative Research and Development.....	7,970	8,395	8,395	3,000	-5,395	-64.3%
Total, Cooperative Research and Development.....	7,970	8,395	8,395	3,000	-5,395	-64.3%

Mission

The Cooperative Research and Development program supports activities of federal/industry/research institute endeavors and federal/state/industry partnerships. It was originally created in FY 1989 and provided the federal share of support for Jointly Sponsored Research Programs (JSRP) at the Western Research Institute (WRI) and the University of North Dakota Energy and Environmental Research Center (UNDEERC). The research projects under the JSRP at those centers receive at least 50 percent cost sharing from non-federal partners. The Department anticipates that these centers can compete successfully for Fossil Energy funding through the competitive solicitation process.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Cooperative Research and Development.....	7,970	8,395	3,000
■ Cooperative Research and Development	7,930	8,355	2,960
In FY 2005, continue support for cooperative research programs at WRI and UNDEERC which are 50-50 cost-shared with non-federal clients. Funding will be split evenly between the two participants.			
FY 2004 and FY 2003 funding provided support for cooperative research programs at WRI and UNDEERC which are 50-50 cost-shared with non-federal clients. Funding was split evenly between the two participants.			
■ Program Support.....	40	40	40
Fund technical and program management support.			
Total, Cooperative Research and Development.....	7,970	8,395	3,000

Explanation of Funding Changes

FY 2005 vs. FY 2004 (\$000)

■ Decrease in Cooperative R&D because it is a lower priority activity	-5,395
Total Funding Change, Cooperative Research and Development	-5,395

Energy Efficiency Science Initiative

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Comparable Appropriation	FY 2005 Base	FY 2005 Request	FY 2005 Request vs Base	
					\$ Change	% Change
Energy Efficiency Science Initiative.....	2,440	0	0	0	0	0.0%
Total, Energy Efficiency Science Initiative.....	2,440	0	0	0	0	0.0%

Mission

Energy Efficiency Science Initiative seeks to identify and fund “bridging” research and development (R&D) that falls between fundamental exploratory science and pre-commercial applied R&D by stimulating R&D that maximizes synergies among different research fields, technologies, investigator communities, and end-use applications. It also cuts across traditional energy end-use sectors by emphasizing distributed power generation applications for industrial and buildings systems, transportation, and stationary power. This initiative expands on existing cooperative efforts between the Office of Fossil Energy (FE) and the Office of Energy Efficiency and Renewable Energy (EE) in areas such as natural gas-fueled turbine and fuel cell technologies, combined heat, power and cooling applications, hydrogen production, and carbon emission sequestration. This effort also involves extensive coordination with the Office of Science in pursuing follow-on research in areas critical to energy efficiency and clean energy development, such as basic biosciences, heat transfer, new materials, catalysts, and computational science.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Energy Efficiency Science Initiative.....	2,440	0	0
■ Energy Efficiency Science Initiative	2,416	0	0

No funding is requested for this activity in FY 2004 and FY 2005.

In FY 2003, EE and FE competitively solicited applications for cooperative agreements to advance research and development of energy technologies at universities and the private sector. Four priority areas of interest identified include: material science, fuels and chemistry science, sensor and control science, and energy conversion science.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
■ Program Support	24	0	0
Fund technical and program management support.			
Total, Energy Efficiency Science Initiative	2,440	0	0